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THE MARYLAND
Agricultural Experiment Station
STATE HORITCULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 60. NOVEMBER, 1904.

FALL TREAMENT FOR SAN JOSE SCALE.

By T. B. SYMONS,
State Entomologist.

GENERAL REMARKS.

The rather unusually good returns that the orchardists of the State have enjoyed the past year will be an incentive; first, to those who have benefitted by the same to give their orchards even more attention than in the past, and secondarily to those who have neglected their orchards to give them better attention in the future.

While there is no doubt that the progressive orchardists in the State have the San Jose scale under control, yet there are many orchards in every locality where the pest is present and doing a deal of injury to the trees. It is for the benefit of the latter class that this preliminary circular bulletin is issued, with the hope that those who have badly infested orchards will give them their attention and apply an effective remedy this fall.

It is of prime importance that fruit growers keep a close watch over their orchards and often examine the twigs and branches of trees so that if they should become infested they will be able to take it in hand before it does any appreciable damage. Where infested trees have been found here and there in an orchard, the scale is in all probability much more generally distributed than an inspection would ordinarily indicate. Under these circumstances the whole orchard should be sprayed. Any signs of failing vigor or unnatural appearance of the bark should at once call for a close inspection. In this way serious loss may frequently be prevented, and the presence of injurious insects or diseases be detected as soon as possible after their establishment in the orchard. When you are in doubt of the trouble send some twigs at once to this office, and the matter will be given immediate attention.

As is well known, the most effective time to treat the San Jose scale is when the tree or plant which it infests is in the dormant state, as at that time the absence of foliage enables more thorough treatment; that is, all of the surface of the tree may be more easily covered, which is very important, and moreover, a stronger wash may be applied against the scale than otherwise would be safe for the welfare of the tree in foliage.

It has been demonstrated that in badly infested orchards two treatments with a dormant wash will prove profitable; that is, one application in the fall after the trees lose their leaves, and the second in the early spring just before the buds begin to swell. But if the orchard is only slightly infested, requiring one treatment this season, it is better to apply it in the early spring. Also if circumstances will allow only one treatment the early spring application will prove more beneficial in controlling the pest.

WASHES THAT MAY BE EMPLOYED.

This circular is a preliminary announcement of the results from experiments by this Department the past year.

LIME, SULFUR AND SALT WASH.

Without doubt, the lime, sulfur and salt wash is preëminently the cheapest and most efficient remedy for the San Jose scale where it can be employed. In our experiments we have employed various formulas and different methods of preparation, which will be enumerated in a coming bulletin of the Experiment Station. Suffice it to say here, that making the wash according to the following formula will give the most effective results with the least trouble of preparation:

Fresh stone lime, 20 pounds;
Flowers of sulfur, 15 pounds;
Common salt, 10 pounds.
Water to make 50 gallons.

Directions: Boil 20 gallons of water in an iron pot or hog scalder; now add the proper quantity of stone lime, also the sulfur, which should have been previously mixed with a little hot water to form a paste. Add the salt a little later when the mass is boiling. If the water was boiling when the lime and sulfur were added, in about 30 minutes, if the mass has cooked vigorously, the mixture should be in good condition; that is, the sulfur should be thoroughly dissolved, producing a clear, amber-colored solution. The mixture should be stirred, and, if necessary, more water added to prevent boiling over or burning. When the mixture has boiled sufficiently, add the amount of hot or cold water to make 50 gallons, and carefully strain, through a strainer having about 20 meshes to an inch, into the spray barrel and apply warm. No doubt the wash will usually work better if hot water is used in diluting the mixture, but we have found equally good results in diluting with cold water; since, if cold water is used to dilute the mixture, the whole solution still remains somewhat warm. This usually saves trouble in heating a greater amount of water.

In making the wash on a very large plan, it is best to employ steam to cook the mixture. Barrels are then used in which to place the materials; it is then made as above stated. It may be mentioned that one can do no harm by cooking the mixture for a longer period than stated here, but 20 to 30 minutes is the minimum after the materials are added to the hot water.

Another method employed by some orchardists is to boil 15 to 20 gallons of water, and pour this amount of hot water into a barrel containing the given amount of stone lime, which in this case should be 30 to 40 pounds, instead of 20 pounds, as they depend on the heat generated by the slacking of the lime to make the combination with the lime and sulfur. The sulfur, in form of a paste, is added with the hot water. The barrel is covered over with a sack to retain the heat, and the mass is occasionally stirred to prevent burning. After the lapse of about 20 or 30 minutes, sufficient cold water is added to make the 50 gallons. The whole is then strained into the spray barrel. If good lime is used, one can secure a fairly good solution by this method, but there is not much labor saved in this manner, and there is no doubt there will be more free sulfur in the solution, thereby reducing the efficiency of the wash.

CAUSTIC SODA.

Many orchardists in the State during the past year have employed caustic soda 78% as a wash against the San Jose scale. In some cases it proved fairly effective in killing a large amount of scale, but in others we have observed very poor results as against the lime, sulfur and salt wash. In our experiments, the caustic soda wash was decidedly unsatisfactory. It is yet to be seen whether the caustic soda will be finally injurious to trees. Our observations to date, from trees that were sprayed last spring, show no signs of injury. No doubt, caustic soda wash is not so troublesome to make as the lime, sulfur and salt; for this reason many prefer using it. For those who care to use this wash, applying it at the rate of 1 pound to 6 gallons of water, will be strong enough to kill quite a number of scale insects.

KIL-O-SCALE.

We have conducted many experiments with this patent insecticide, and we are not prepared at this time to either condemn or recommend it. We would not advise orchardists using it at this time, until more work can be done with it. In our earlier experiments at the rate of 1 part of Kill-o-scale to 20 or 30 parts of water, as the manufacturers recommended it, did not give satisfaction. Some later tests with modified and stronger solutions, applied while the young were crawling, showed fairly good results.

WEBCIDE.

This is another patent insecticide which is on the market and which we have included in our experiments. Our results indicate that it is not a satisfactory remedy for the San Jose scale.

CON-SOL AND SAN JOSE EXTERMINATOR.

These solutions are claimed to be extracts of the lime, sulfur and salt wash, or rather the total amounts of the different materials used for making a barrel of the wash in the regular manner concentrated to one gallon. They recommend that this gallon be diluted to 50 gallons of water. These solutions, while they kill some scale, cannot be recommended at this time as an efficient remedy for scale, as the regular lime, sulfur and salt wash.

Each of these patent preparations are more expensive than the regular lime, sulfur and salt wash.

WHALE OIL SOAP.

This substance is effective in controlling the San Jose scale, but its expensiveness has no doubt prevented its adoption. Whale Oil Soap should be applied in early spring at the rate of 2 pounds to the gallon of water.

MODE OF APPLICATION.

Any pump that has all the working parts brass and furnishes a constant high pressure may be used, and, in general, a nozzle that is suitable for the application of Bordeaux Mixture can be used with any of the above mentioned washes. Always clean the pump thoroughly after using by washing out with hot, clear water.

In applying lime, sulfur and salt wash and caustic soda, as they are somewhat disagreeable to use, the sprayman should provide himself with a rubber or oil skin coat, hat and gloves, and many have found a pair of goggles, with clear glasses, very useful. It is a good plan to throw a blanket or sack over the horses. In the application of these washes, the main point to be observed is to be very careful that all the parts of the tree are treated. It is of advantage to have the hose of sufficient length to enable the sprayman to encircle the tree and finish it before leaving. Upon drying, trees treated with the lime sulfur and salt wash present a whitened appearance, very much as if whitewashed, and it is then very easy to detect any parts that have not been treated.

There are many good spray pumps on the market, and it is left to the individual to decide and select the one best suited to his needs. There are also several power sprayers available. We hope to experiment with some of these at the coming meeting of the State Horticultural Society, which will be held at the Maryland Agricultural College, College Park, Md., Dec. 28 and 29, 1904.

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STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 58. MAY, 1904.

CABBAGE DISEASES AND INSECTS.

By J. B. S. Norton and T. B. Symons.

The importance of the cabbage industry to Maryland, and the fact that at least 10 per cent of the whole, and often on some farms 25 or even 50 per cent of the yield, is lost through the depredations of insects and the attacks of fungous diseases, make desirable a consideration of the means of saving at least a part of this great loss.

CABBAGE DISEASES,

By J. B. S. Norton, State Pathologist.

GENERAL HEALTH CONSIDERATIONS.

Cabbage can withstand a great deal of abuse and do well if supplied with proper food and water ; wet soil and hot dry air, however, are both detrimental. In the plant bed the principal dangers are want of light and crowding, and too hot and moist air; though they will stand a great deal of the latter. When the plants are grown in dark, close places, or crowded too much, they may be attacked by various "damping-off" fungi which kill the lower part of the stem. Proper conditions will prevent this, and more light and air and stirring the soil about the plants will check it. All roots, leaves and other waste from plants affected with club root, black rot, soft rot or wilt, if collected and burned will much reduce the chances of infection the following year. In transplanting the roots should be preserved as nearly entire as possible and not doubled back in planting ; the cabbage is especially dependent on a good supply of water which must come through the root, so the plants need an abundance of roots since they cannot stand a wet soil.

In successful cabbage culture it is especially important to eradicate all weeds belonging to the cabbage or mustard family, and to not grow in rotation with radishes, horse radish, kale, etc., which are subject to the same diseases. Long rotations are important to prevent disease.

MILDEWS, ETC.

Downy mildew is recognized by spots of injured tissue on the leaves, on which the fruiting organs of the fungus, *Peronospora parasitica*, are seen as a delicate, white, downy appearance. It is rarely troublesome, except on young plants, and is increased by moist air. Injury can be much reduced by forcing the plants with nitrate of soda, spraying with Bordeaux mixture and reducing the water supply until the plants outgrow it. Strong Bordeaux mixture should not be used as it is slightly injurious to cabbage. Four pounds of copper sulphate and four pounds of lime to fifty gallons of water is a good formula.

Powdery Mildew, caused by *Oidium Balsamii*, and White Rust, *Albugo candida*, occasionally cause similar injury, but the spore-bearing areas appear as less downy, white patches on the leaves.

A black mould fungus, *Macrosporium Brassicæ*, is also seen frequently on cabbage in this State, causing black spots on the outside leaves, but does not do serious injury to cabbage that is well cared for.

CLUB ROOT.

This disease, causing the roots to become distorted and knotty, and the plants to develop imperfectly or die, is caused by a minute organism, *Plasmodiophora Brassicæ*, which lives in great numbers in the diseased root. It is most troublesome in low, wet lands. It was introduced from Europe, and is not generally distributed in Maryland, but is very bad in some localities. Care should be exercised not to distribute it over the field when the presence of occasional distorted roots indicate that it is getting a foothold on the place, as the germ is said to remain active in the soil for 20 years. The same disease is found on turnips, and weeds like mustard, shepherd's purse, peppergrass, cress, etc., and these propagate it when cabbage is not present. Good drainage and cultivation are the most helpful treatments. From 75 to 100 bushels, according to the character of the soil, of air slacked lime applied to the land the autumn before planting, has been very helpful. Abandonment of the infected land for cabbage culture for as much as seven years is often necessary.

BLACK ROT.

Black rot has not been prominent until recent years, but is now causing serious injury on many farms in this State and elsewhere. The disease is caused by a kind of bacteria, *Pseudomonas campestris*, the germs of which enter the plant through the water pores on the edge of the leaves where the drops of exuded water may be seen after a cool, damp night, or through insect injuries on the leaves or broken roots in the soil. The disease is best recognized by the yellowing leaves with brown or black veins which are injured by the bacteria and in which they occur in countless numbers. The heads may become dwarfed or be entirely wanting. The disease also occurs on turnip, kale, cauliflower and similar plants, and on wild mustard and other cruciferous plants. Probably some varieties are more subject to the disease, but this has not been definitely determined. Conditions most favorable for cabbage growth favor the disease.

TREATMENT: Make the seed bed far away from where other cabbage has been grown and take precautions to keep the soil from being infected through manure. Burn over the bed before sowing the seed and do not set plants that show signs of the disease on the young leaves. Do not plant on infected ground, or even, if possible, where cabbage has been grown until after some years, if the disease is in the neighborhood. The diseased plants should be kept from manure, and for this reason should not be eaten by animals. Keep down the cabbage-eating insects which carry the disease. Market the crop early to prevent further decay in storage. It is very important to keep the germs out of the soil, for if once infected, it is almost impossible to get the land free again.

WILT.

A disease caused by a species of Fusarium, a soil fungus, acting somewhat like black rot, and also causing the leaves to wilt and drop off one by one leaving a bare stem and a tuft of leaves on top, is bad in many places in Maryland. When it is found the land must be abandoned for cabbage growing and every precaution taken to keep it from spreading.

SOFT ROT.

Soft rot, caused by one or more species of bacteria, often attacks growing cabbage, causing a soft, brownish decomposition of the lower or central part of the head, especially on thrifty, succulent plants. The same occurs in storage piles. No field treatment can be recommended

To prevent rotting when cabbage is kept in piles or trenches for winter use, the heads should be pulled in dry weather, and before covering all water should be drained from the leaves, and if soft rot, or black rot was present in the field, all heads showing signs of rot at the base of the head or on the leaves should be discarded or stored by themselves. The important point in storage is to protect the heads from water, but keep them moist and as near freezing temperature as one can without reaching it.

SOME INSECTS AFFECTING CABBAGE,

T. B. Symons, Associate State Entomologist.

THE IMPORTED CABBAGE BUTTERFLY (Pieris Rapæ).

All cabbage growers are familiar with this little yellowish white butterfly with black spots that darts here and there over the cabbage patch. It is the adult of the dreaded cabbage worm, which, without doubt, is the worst cabbage pest that market growers have to contend with. The butterfly appears as early as the first of March in this locality, and at once commences laying eggs on the cabbage, turnips, radishes or mustard. The larva hatches from the egg in about ten days. After feeding for about ten days it crawls to any dry rubbish or fence and changes to the pupa. It remains in the pupa state about twelve days, when the adult butterfly emerges. There are many generations during the season, until finally, in the late fall, the insect either winters over in the adult or pupa state.

When the worms are present on the cabbage, without doubt Paris green and London purple are the most reliable remedies to be used. Some growers are afraid to spray their cabbage plants with an arsenite when they are half grown, or larger; but there is not the slightest danger of injuring anyone by such procedure. For if the cabbages were sprayed the day before cutting, and then treated in the usual way by the cook, one devoted to the vegetable could not devour a sufficient quantity to cause him the slightest apprehension from the poison. Spraying the plants with an arsenite about one-third of a pound to 50 gallons of water will be effective in controlling the pest. Slacking about a pound of lime and adding to the arsenical solution will help in causing the solution to remain longer on the leaves. Applying the arsenite in powder form, that is, by adding one part of the poison to fifteen or twenty parts of flour or plaster and dusting on the plants, preferably in the morning, will give the desired results. If, however, one should not like to use Paris green where the plants are heading, applications of Hellebore will be effective and the poison will disappear more rapidly. Kerosene emulsion can also be applied with some success.

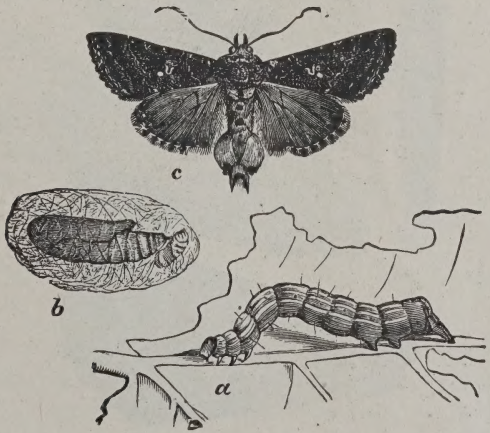
The Imported Cabbage Butterfly, male (After Riley).

The Imported Cabbage Butterfly, female (After Riley).

As a preventive against the attacks of this insect, planting turnips, radishes or some other plant of the mustard family that flowers early in the season, on the border of the cabbage field, will attract the butterfly, and possibly the pest could there be given more thorough treatment.

THE CABBAGE PLUSIA (Plusia brassicæ).

This insect does considerable injury to cabbage, especially later in the season, and in fact its injury is often times considered to have been done by the common cabbage butterfly. The moths, which are nocturnal insects, appear in the spring and lay their eggs similarly to the



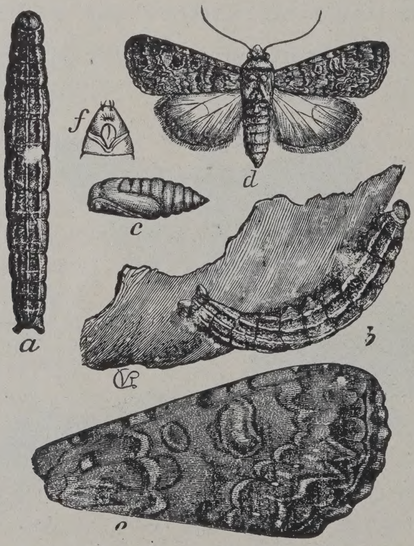
The Cabbage Plusia; a, caterpillar; b, chrysalis in cocoon; c, moth, male (After Riley).

cabbage butterfly. The larva, in which stage the insect does its damage, is dark green, but distinctly marked with white longitudinal lines. They are not provided with prolegs in the sixth and seventh seguments, like most nocturnal insects; so, in traveling over the surface of a leaf, they loop the body like the "measuring worm." Upon reaching maturity, the larva, instead of crawling away to pupate around rubbish or fences like the cabbage butterfly, crawls to the under side of a leaf, spins a thin cocoon and changes to a chrysalis. The period spent in the chrysalis ranges from fifteen days to three weeks, when it emerges as an adult moth. The moth is dark gray in color with a wing expanse of about 1½ inches, and marked with a bright silvery dot and V-shaped mark near the centre of each front wing. There are probably three or four broods in this State.

The remedies suggested for the cabbage butterfly can be employed with effectiveness against this pest.

THE CABBAGE MAMESTRA (Mamestra trifolii).

The larva of this moth is often seen in connection with the cabbage plusia and the imported cabbage butterfly. Its larva can easily be distinguished from others by a pinkish stripe down each side. The caterpillar is quite variable in color, some being bright green above and some



The Cabbage Mamestra; a, b, larvæ; c, pupa; d, moth; e, wing of same, enlarged. (After Riley).

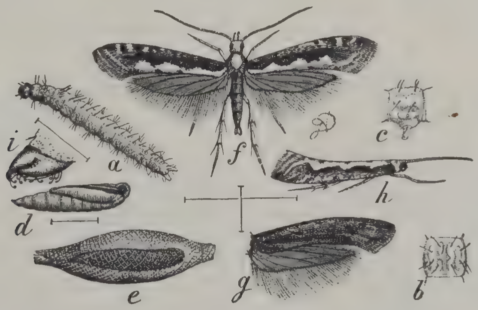
nearly brown; but all have the characteristic stripe on each side. The parent moth is somewhat variable in both size and color, ranging from a pale yellowish-gray to a dark brownish-gray. It is readily distinguished from the moth of the Plusia by the lack of silvery spots in the upper side of the fore wings. The insect winters in the pupa state, the moths appearing in early spring. There are at least two broods in this latitude.

The insect does its injury by eating the leaves and boring into the heads and stems of the cabbage, and has the habit usually to feed at night, remaining under stones and clods of earth during the day. They are also reported to feed extensively upon the common pursley.

When this insect occurs in injurious numbers, the best remedies will probably be found in the use of poisoned baits, and in the application of arsenites on the plants.

THE CABBAGE PLUTELLA (Plutella cruciferarum).

This little active pale-green worm, about an inch in length, does much damage at times by eating the outer leaves of the cabbage and other *Cruciferæ.* The larva pupates within a beautiful, delicate, gauze-like cocoon, through which the enclosed pupa can plainly be seen. The adult insect is of an ash gray color, with narrow wings expanding about five-eighths of an inch. There are probably three or more broods in this latitude. The insect winters in the pupa state. Likewise with this pest the application of arsenites or kerosene emulsion will be effective. The preventive of clean culture and destroying all rubbish along fence rows will curtail the presence of many of the so-called cabbage worms.



The Cabbage Plutella; a, larva; d, pupa; e, cocoon; f, moth; greatly enlarged. (After Riley).

THE CABBAGE ROOT MAGGOT (Phorbia brassicæ).

While this pest is commonly known as the cabbage root maggot, it by no means restricts its ravages to this plant, but usually confines itself to the *Cruciferæ* or mustard family.

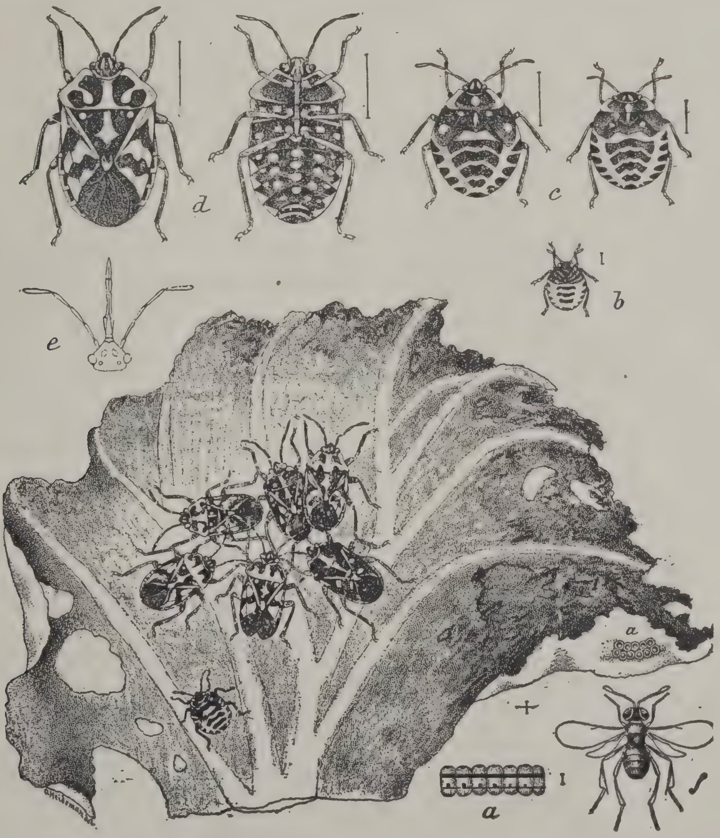
According to Prof. Slingerlana, Bulletin 78, Entomological Division, Cornell University, the adult fly appears in the early spring and lays her eggs on the soil near the stem of the young cabbage plants, usually after they are transplanted to the field, although injury has been reported by this insect to plants in the beds. In a few days the eggs hatch and the young maggots attack the surface of the roots. They then work their way to the tender rootlets; when these are destroyed the maggot works on the main root, into which it burrows. Upon reaching maturity, it is about a half inch long, shining white and cylindrical in form. It crawls an inch or two into the soil away from the roots, and there enters the pupa state. The fly emerges about three weeks later and crawls to the surface. The female then commences to lay eggs for the second generation. Prof. Slingerland reports a second brood; the flies of this second brood appearing about June 15 and the maggots working in July. It is probable that the insect winters in the pupa and adult stages. The presence of this insect on cabbage and allied species of plants is detected by a checking of their growth and a tendency of the leaves to wilt badly under a hot sun. In a few days afterwards the whole plant wilts and dies.

In bulletin 27, Entomological Division, Cornell University, Prof. Slingerland discusses at length the remedies that have been put forth by different experimenters, and among the more important may be mentioned the placing of tarred paper cards around the plants before setting out into the field, to prevent the adult from laying eggs or the larva from getting at the desired point. The application of carbolic acid to the plants after they are set, using the following formula: 1 pound hard soap dissolved in 1 gallon boiling water, into which 1 pint crude carbolic acid is poured and the whole mass agitated into an emulsion, and taking 1 part of this standard emulsion and diluting it with 30 equal parts of water; treating shortly after the plants are set out and repeating once each week or ten days until about May 15 will be sufficient. It is necessary to remove some of the earth from about the plants before treating. Applying the ordinary kerosene emulsion, diluted to 15 per cent, would give equally good results.

Carbon bi-sulphide has also been used with success. This liquid is injected into the soil a short distance from the plants, the former passing through the soil and killing the insects at work on the plant without injuring it. Care must be exercised not to allow too much of the liquid to pass through the soil and hurt the plants. If the cabbages are grown extensively, this remedy may prove to be expensive. More detailed information upon the treatment of this pest will be given upon application.

THE HARLEQUIN CABBAGE BUG (Margantia histrionica).

There is no doubt that this insect is the more troublesome to many of our gardeners. It invariably appears each year in our cabbage patches in enor-



The Harlequin Cabbage Bug; a, eggs enlarged; b, young enlarged; c, young more enlarged; d, adults seen from above and below, enlarged: e, outline of head of adult, enlarged; f, parasite enlarged. Other figures natural size. (After Johnson.)

mous numbers. The adult presents a bright mottled red, yellow and black appearance, which renders it conspicuous. The insect is nearly half an inch long and about half as broad. It winters in the adult state, under rubbish or in such crevices as it may find large enough to crawl into. In spring, when the warm weather sets in, it appears and feeds on whatever cruciferous plants it may find. They are particularly fond of mustard plants, and will often live on these until midsummer. The eggs are laid on the under side of the leaves, and hatch in from four to ten days, according to the temperature. The young larva at once begins its work, thrusting its beak into the plant tissue and extracting its juices, thus causing the plant to wilt and eventually die. The young reach maturity in from 16 to 30 days. According to Dr. Smith, there are from three to four generations in this locality during a season.

This is a most difficult insect to control from the fact that diluted insecticides have proved of little use against the pest, and when solutions have been applied strong enough to kill the bugs, the plants have been injured. The planting of trap crops seem to have given the best results, that is, planting radishes or mustard around the edges of the proposed cabbage patch before the cabbage plants are set out. The insects will congregate on these plants, and can be effectively destroyed either by applying a strong insecticide or by catching the insects. Pure kerosene is effective in killing them when it is not cared whether the trap plants are injured. Commencing early in the season and picking the bugs from the plants will prevent much future trouble from the second brood. The preventive of clean culture and cleanliness about the farm buildings, fences, etc., will greatly reduce the presence of this pest the following season.

CABBAGE APHIS (Aphis brassicæ).

This is likewise a very common cabbage pest. A cabbage plant is often seen covered with these little lice, which suck the juices from the plants. The insects may winter in either the egg or adult state; the latter, especially, in pits where cabbage is stored. They appear in the spring and increase in enormous numbers. Injury can be prevented by a prompt removal of all plant remnants left in a field after the heads are taken out. Clean culture is emphasized, as the insects will live on all cruciferous weeds. When the insect appears on the cabbage, spraying the plants with kerosene emulsion diluted to 10 or 15 per cent, or with a tobacco decoction will be effective in controlling them.

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STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 57. APRIL, 1904.

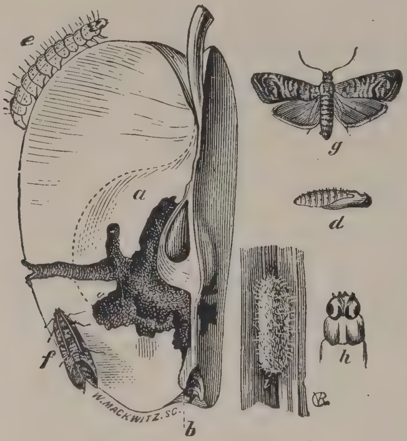
Some Insects that Attack Fruit Trees in the Spring.

By T. B. SYMONS, Associate State Entomologist.

There are many injurious insects which we may call annual visitors, although there can be no law laid down as to their respective appearance in any particular year. It is, therefore, urged that each orchardist be on the lookout for the first appearance of the pests and apply remedial measures at once, as often much future injury can be prevented by immediate action.

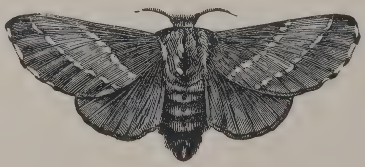
APPLE APHIS (*Aphis Sp.*)—Very often these little insects do a considerable amount of damage to the foliage of apple trees, but especially do they retard the growth of young trees when attacked by them. There is no excuse for allowing the aphids to appear in sufficient numbers to injure the foliage. As is well known the insects winter in the egg state, the eggs being laid on the terminal twigs around the buds. When the buds begin to develop the eggs hatch, and the young aphids commence sucking the vitality from the tender foliage. In trimming the trees in spring, the twigs on which the eggs are laid should be cut off. If, however, they are left, when the aphids appear in the early or late spring according to the species, the twigs of trees should at once be sprayed with either kerosene emulsion at the rate of 15 per cent or "rose leaf," a tabacco extract, diluted to one part of the extract to 40 or 50 parts of water. These remedies can be employed against all species of aphids that appear during the year.

THE CODLING MOTH (*Carpocapsa pomonella*)—Much injury each year is occasioned by the attacks of this insect. As the name indicates, the adult is a moth which appears in the spring about the time that the apple buds open. It is thought that the majority of the eggs are laid in the calyx end of the blossom. The eggs hatch in a few days and the larvæ begin to eat their way into the young apple. After attaining its growth, the larva eats its way out of the apple, and pupates in a crevice on the tree or in the ground; the second brood appearing about July. Apple trees should be given one spraying with an arsenite, just as the petals drop off the blossoms, so as to catch the larva before it enters the apple. A second spraying about two weeks later would be advisable to catch the larvæ from the late appearing moths. The trees should also be sprayed about the first of July in order to kill the larva from the second brood. It is good policy to apply the poison in combination with Bordeaux Mixture, 1-4 pound of Paris green or other arsenite to 50 gallons of Bordeaux.



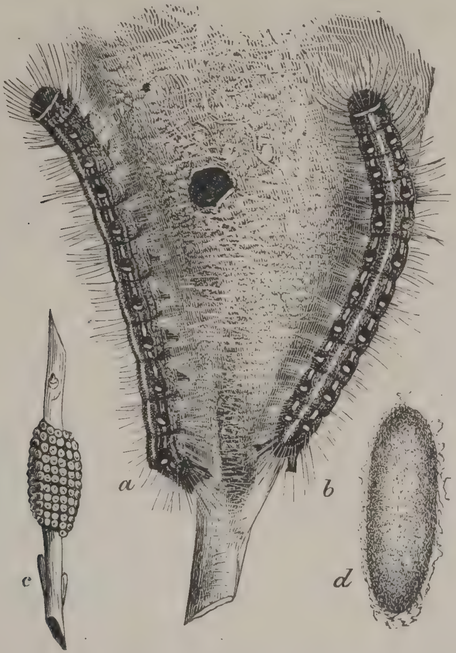
The Codling Moth. a, Apple showing the work of the larva; b, point of entrance of the larva; d, pupa; e, larva; f, g, moth; h, head of larva; i, cocoon.

THE APPLE-TREE TENT-CATERPILLAR (*Chisiocampa Americana*)—This caterpillar very often does damage in defoliating apple trees in the spring. The insect winters in the egg state; the eggs of the moth being laid on the twigs of the apple tree the preceding summer. In the spring the eggs hatch and the larvæ begin feeding on the foliage. The caterpillars develop to be quite large and therefore can easily be seen, as they appear in large clusters, and they can often be killed by either cutting off the



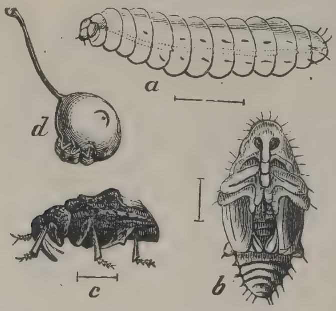
Apple-Tree Tent-Caterpillar—an adult moth (after Riley).

branch upon which they are or they can be burnt by a torch. A practicable remedy, however, is an application of an arsenite to the foliage.



Apple-Tree Tent-Caterpillar. a, b, larva; c, eggs; d, cocoon (after Riley).

THE PLUM CURCULIO (*Conotrachelus nenuphar*)—Year after year this little beetle does damage to fruits to a greater or less extent. It does not confine its ravages to the plum, but other stone fruits are likewise attacked. The insect winters in the adult state and appears in early spring, feeding upon the unopened buds and afterwards upon the young leaves of the plum, peach, apricot, cherry and pear. Later when the fruit has set, and is about the size of a marble, the female makes a crescent shaped slit and, lifting the flap from the surrounding tissue, deposits her egg. In a few days the egg hatches and the tiny larva begins to feed on the flesh of the fruit, boring a channel as it proceeds, until it reaches the center, where it feeds around the stone. In from three to five weeks it attains its full growth and by this time the irritation arising from the wound and the gnawing of the grub causes the fruit to become diseased and generally it falls to the ground, whence the larva leaves the fruit and enters the ground to pupate. In from three to six weeks the adult beetle emerges and winters over in secluded spots until next spring. When the beetles appear early in the spring and do damage by eating foliage, the trees should be sprayed with an arsenite. This treatment will often prevent further injury to the trees. The most damage, however, is done by this insect later by puncturing the fruit. At this time the best remedy is

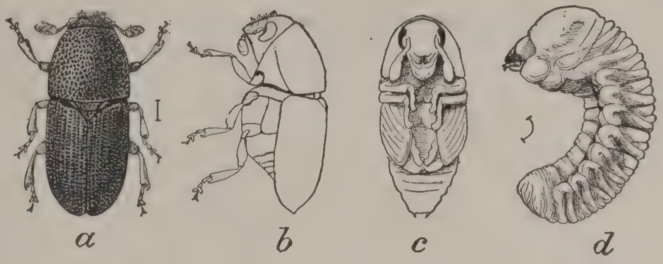


The Plum Curculio. a, larva; b, pupa; c, adult; d, crescent shaped slit on fruit (after Saunders).

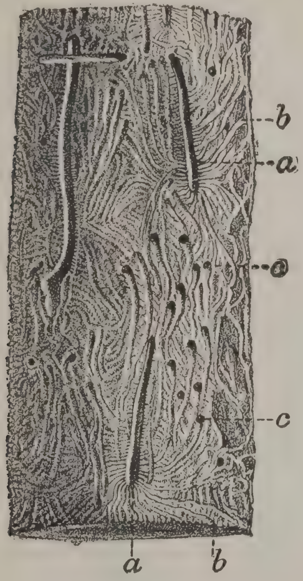
to catch the beetles by spreading a sheet under the tree. By suddenly jarring the tree the beetles will fall in the sheet where they can be destroyed. There are many handy forms of culculio-catchers made, and it is left to the orchardist to employ the one best suited to his needs. The only point to be borne in mind is to have the sheet extend under all of the tree. Care should be taken in jarring the tree not to scar it. A stout pole wrapped at one end with an old sack is generally used. As the beetles are less active in the early morning, this work should be done at that time, the earlier the better.

FRUIT-TREE BARK-BEETLE (*Scolytus rugulosus*)—Orchardists should be on the watch for the appearance of this insect in their orchards. Last year many complaints were received at this office that many trees were killed by its ravages. Its presence is detected by minute openings about the size of small shot on the outer bark of the tree and in stone fruits by more or less copious exudations of gum. In the early spring the beetles attack the young twigs, making their hole near the bud. Later, however, the insect works on the larger branches and trunk. The usual habit of the pest is to attack sickly or half dead trees, but it was witnessed on many occasions last season that the beetles left the dead trees and attacked perfectly healthy ones.

The parent beetles make their appearance in early spring and may be seen crawling about the orchard trees and beginning to burrow through the bark. After reaching the sap wood the females construct vertical galleries, along the sides of which they gnaw little pockets where the eggs are deposited. In a few days the eggs hatch and the larvæ, according to Prof. Chittenden, Department of Agriculture, are about 20 days attaining maturity. The period of pupa state, as observed by Prof. Chittenden, is about seven days, and thus we have the life cycle to be from four to six weeks. There are probably three or more generations during a season.



The Fruit-Tree Bark-Beetle. a, adult beetle; c, pupa; d, larva, all magnified. (From Chittenden, Div. Ent., U. S. Dept. Agri.)

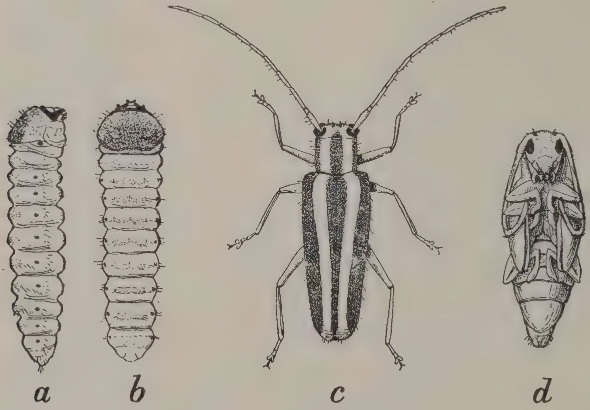


Showing galleries of fruit-tree bark-beetle under bark of twig. a, a, main galleries; b, b, side galleries; c, c, pupal cells; natural size. (From Chittenden, Div. Ent., U. S. Dept. Agri.)

Showing work of fruit-tree bark-beetle on a twig of apple. (From Chittenden, Div. Ent., U. S. Dept, Agri.)

When a tree is seen to be infested with this pest, it is best to destroy the whole of the infested parts by burning, as this plan will prevent future injury. It is also of prime importance to keep all brush wood and other remnants of orchards destroyed, as brush piles and the like offer ideal places for the pest to reproduce. If such is destroyed and the orchard trees be kept in vigorous health, they will more readily be able to withstand the borer's attacks. Many deterrent washes have been employed with little success, but if the insects are detected at the outset of their attack, touching lightly the infested parts from which the gum has begun to exude, with a sponge saturated with kerosene emulsion, may prevent such damage. It is an exceedingly difficult insect to control and it is only left for the orchardist to be on the watch for its first appearance.

THE ROUND-HEADED APPLE-TREE BORER (*Saperda candida*)—This and the Flat-Headed Apple-Tree Borer, (*Chryrobothris femorata*), are pests which often-times are the cause of considerable injury to apple trees. There is little difference in their life history, as both winter in the larvæ state, but in case of the round-headed borer, it is thought that the larva is three years reaching maturity; while it may take two seasons before the larva of the flat-headed borer will change to a pupa. The pupa stage in both insects extends over about three weeks, when the adults emerge during the months of June and July. The female beetles lay their eggs on the bark of the tree near its base. Within two weeks the young larvæ are hatched, and at once commence, with their sharp mandibles, to gnaw their way to the interior.



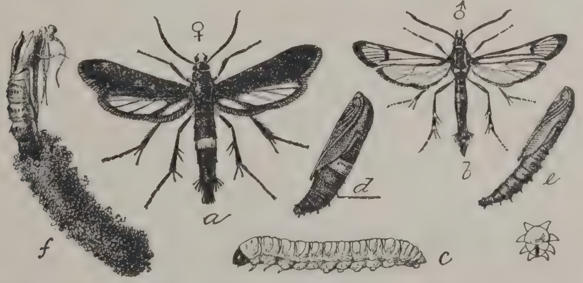
The Round-Headed Apple-Tree Borer. a, larva from side; b, from above; c, female beetle; d, pupa; all enlarged one-third (after Chittenden, circular No. 32, S. S. Div. Ent., U. S. Dept. of Agri.)

The insects do their damage by the larvæ boring into the tree and thereby devitalizing it. Their presence may be detected in young trees from the bark becoming dark-colored and sometimes dry and dead enough to crack. Through these cracks some of the castings generally protrude and fall to the ground in a little heap; this takes place generally in the spring of the year, when, with the frequent rains, the heaps become swollen by absorption of moisture.

When trees are found to be infested with these borers the ground should be taken from around the base of the tree and the borers cut out. If they cannot be reached with a knife, a stout wire is often used to push in their holes and thereby kill them. This, however, is best done in September, when the larvæ are just below the outer bark. Those that pass over the winter should be killed in the spring so as to prevent future trouble.

Among preventive measures, alkaline washes are probably the most efficient, since experiments have demonstated that they are repulsive to the insect, and that the beetle will not lay her eggs on trees protected by such washes. Soft soap or whale oil soap at the rate of two pounds to the gallon of water, applied to the bark of the tree, especially at the base or collar and up the trunk to the crotches, will cover the surface liable to attack. The soap solution should be applied early in June, and a second time during the early part of July.

PEACH-TREE BORER (*Sannina extiosa*)—Likewise with this pest we have an insect that does its damage by boring into the trunk of the peach, plum and cherry. Its presence can be detected by the brownish, gummy exudations more or less soiled with earth and the larvæ excrement about the base of the trees. This insect does its damage by mining between



The Peach-Tree Borer. a, adult female; b, adult male; c, full-grown larva; d, female pupa; e, male pupa; f, pupa skin extruded partially from cocoon; all natural size (after Marlatt, circular No. 17, S. S. Div. Ent., U. S. Dept. Agri.)

the bark and sap wood, often completely girdling and causing the death of the tree, and always greatly injuring and weakening it.

The adult insect, a slender dark blue moth, appears as early as May in this latitude and at once commences to deposit its eggs on the bark, usually at or near the surface of the ground. The young larva upon hatching immediately burrows into the bark of the tree. It feeds steadily during the summer and fall; constantly enlarging its exudations of gum as stated above. It winters in the larva and resumes feeding in early spring, until reaching maturity. It then transforms to the pupa, and in a few days the adult emerges.

It is advisible to examine your trees in the fall and spring for the presence of this insect. When present at either time, the best remedy is to use the knife and cut them out or a stiff wire which can be thrust into their holes so as to kill them. "Worming," as it is called in the fall, is preferable, from the fact that the larvæ can be more easily found. If, however, this is not done in the fall, the trees should be wormed in the spring to prevent future trouble from the pest.

Among preventive measures, the placing of sheathing paper around the trunk of the trees may be mentioned. Also coating the trunk with a heavy whitewash, with the addition of glue or soft soap, will prevent the adult female from depositing her eggs.

A solution made of soft soap and a half pint of crude carbolic acid, with two ounces of Paris green mixed in a bucket full of water, and enough lime and clay to make a thin paste, applied to the trunks will be effective in preventing injury from the insect.

It is hoped that the orchardists troubled with these or other insect pests, will communicate with the State Entomologist, College Park, Md., for further information in regard to their control.

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THE MARYLAND
Agricultural Experiment Station
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 56. (2nd Edition.) MAY, 1904.

CROWN GALL.

By

J. B. S. Norton, State Pathologist.

The purpose of this circular bulletin is to call the attention of growers to the character of crown gall that they may exclude it from their orchards, and to give some suggestions to nurserymen about the prevention of it in nurseries. "Hairy root" is considered here with crown gall since they usually occur together and are considered by many to be forms of the same disease. This circular applies particularly to the disease on apple.

NAME AND CHARACTERISTICS.

The term crown gall is used to designate a disease affecting various fruit trees and other plants, and causing rough knots or enlargements on the roots, usually just below the surface of the ground, but often on the small roots lower down, and occasionally on the stem. The galls are usually easily distinguished from all other similar swellings by their peculiar rough, warty surface and somewhat hemispherical outline. Their character can best be indicated by the illustrations given on these pages. On apples the galls are usually accompanied by an abundance of fibrous roots. According to Popenoe young trees affected can be distinguished while in the ground by a growth of branches low down on the trunk late in the season. Aphis galls are quite different as shown by Plate V.

INJURIOUS CHARACTER.

The galls, when they occur on the main root, may interfere with the transfer of sap in the tree and thus weaken it. The constriction by the gall may cause the tree to fruit too young or to over bear. They cause abnormal root development and thus hinder growth. They are often so well developed as to cut off and cause the death of the tap root which is almost always killed when affected throughout by the hairy-root condition. The tissue of the gall may decay and form an entrance for wood-rot fungi which will soon destroy the tree. The gall also weakens the trees at the crown, so that they are easily broken down by wind. The gall is especially destructive to peach and other stone fruits and to raspberries. Unless well developed when taken from the nursery, it probably does not seriously injure apple trees unless they are afterwards grown under unfavorable conditions. But many cases can be cited where apple trees have died from the gall or shown marked injury from it especially when young.

HISTORY.

Crown gall has been known in some nurseries for many years, but has in recent years become very prevalent, and is now found in most nurseries, and in a large part of the orchards in the southern and central parts of the United States. It does not occur so much in northern sections. Little notice, apparently, was taken of this affection before 1892, when the Department of Agriculture published a note regarding it. Following the thorough work of Toumey on this disease in Arizona, showing its destructive character on certain kinds of fruit trees, the attention of orchardists and nurserymen has been attracted to the disease, and it has been sometimes indiscriminately condemned on all classes of trees by nursery inspectors, and without consideration of the great loss to nurserymen.

INFECTIOUS CHARACTER.

Healthy plants of apple, peach, plum and raspberries have been by experiments, at the Missouri Experiment Station and elsewhere, successfully inoculated from galls taken from each of the before-mentioned kinds of fruits; indicating that the same germ is the cause of all and that the disease may spread from one to the other.

CAUSE.

Toumey found an organism in the almond galls, that he studied, which seemed to be the parasite causing them. Such parasites, however, have not been found by other investigators, but all evidence is in favor of such a cause. The disease is mostly introduced into nurseries on affected seedlings, which in apple are quite readily distinguished by the unusual amount of fibrous roots.

PREVENTION IN ORCHARDS.

Whenever nursery stock is purchased it should be carefully examined, and none that is affected with gall should be planted. This is especially true of peach and raspberry, and the least indication of gall on these should be thrown out. Sometimes nurserymen cut off the galls before shipment, but such trees should not be purchrsed as the gall will almost always develop again when removed. Apple trees slightly affected, often apparently, recover and make good trees, but even then the life of the tree may be cut short and the ground infected. It is certainly best to plant unquestionably good trees rather than doubtful ones although they cost more, and in dealing with nurserymen this point should be considered.

Maryland nurseries are inspected for crown gall and proper arrangements made to prevent the sale of stock so diseased. Our nurserymen are especially careful to discard crown gall when digging, but it may come in from other States, and orchardists are advised to be on the lookout for it.

It will not be best to plant new orchards on ground where old orchards infected with crown gall stand or on ground draining from this.

For destroying the galls on trees many substances have been tested, but none can be recommended as satisfactory.

PREVENTION IN NURSERIES.

Do not use seedlings affected with "hairy root," or with indications of galls. If possible obtain seedlings from nurseries where crown gall is not present. Many recommend the French seedlings as cleaner, but others condemn them.

When possible plant on land where susceptible kinds of trees or plants have not been recently grown.

In grafting the disease may be communicated from diseased to healthy trees by means of knives, etc.

The wounds made in grafting, cultivating, etc., furnish points of entrance for germs of the gall, so such should be avoided or protected as much as possible; as a rule budded stock has less gall.

There seems to be more gall where the point of union in grafts is close to the surface of the field, the galls requiring air for development.

Some varieties are more susceptible to the disease.

The disease cannot be entirely prevented as it is so thoroughly distributed over the country, but since many nurseries are now free from it and the amount affected varies greatly from year to year in the same nursery, as different methods of planting, culture, etc., are followed, it certainly can, after nurserymen acquire more experience with it, be reduced enough that it will cause little financial loss.

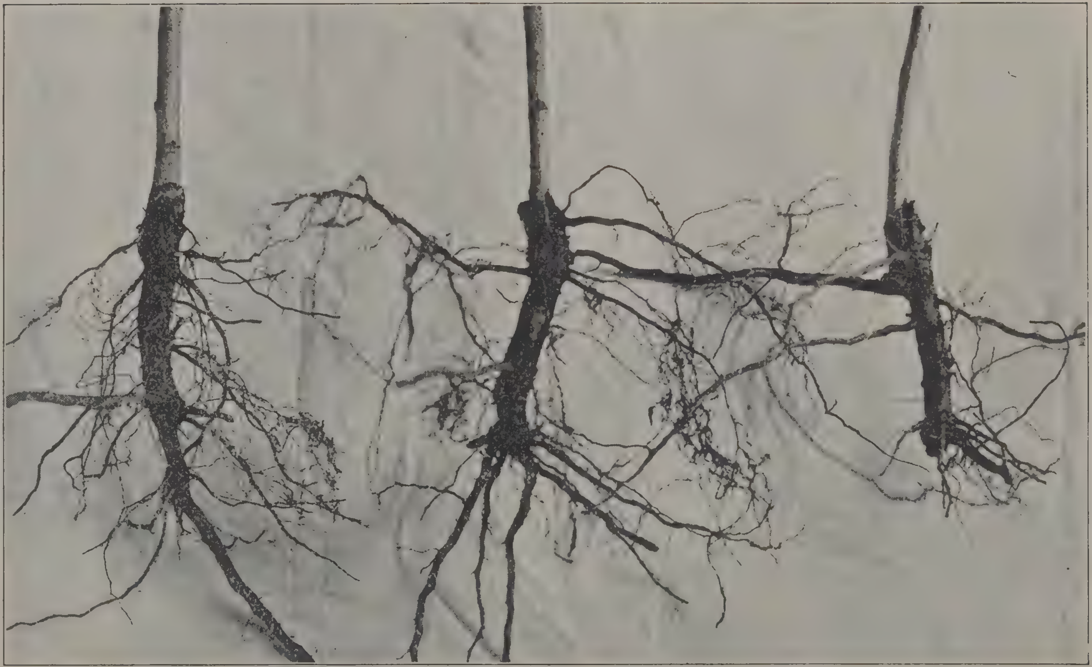


PLATE I—One-year apple grafts with healthy roots. (After Alwood.)

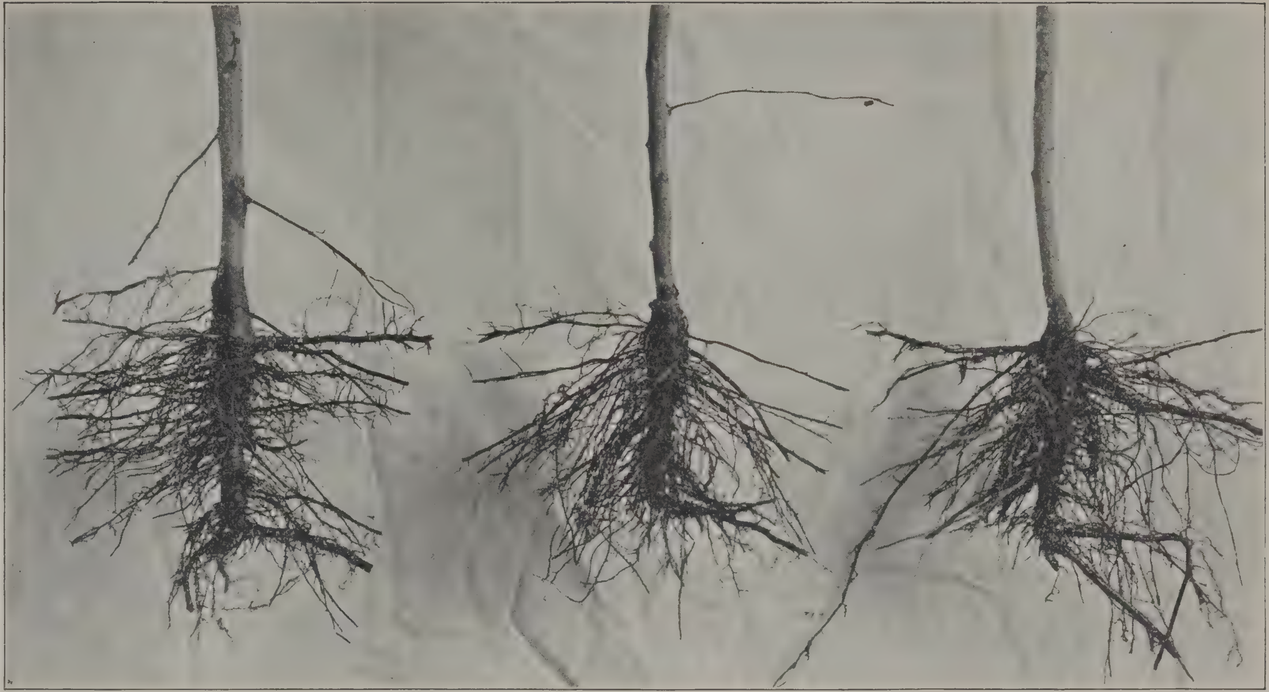


PLATE II—One-year apple grafts with "hairy roots." (After Alwood.)

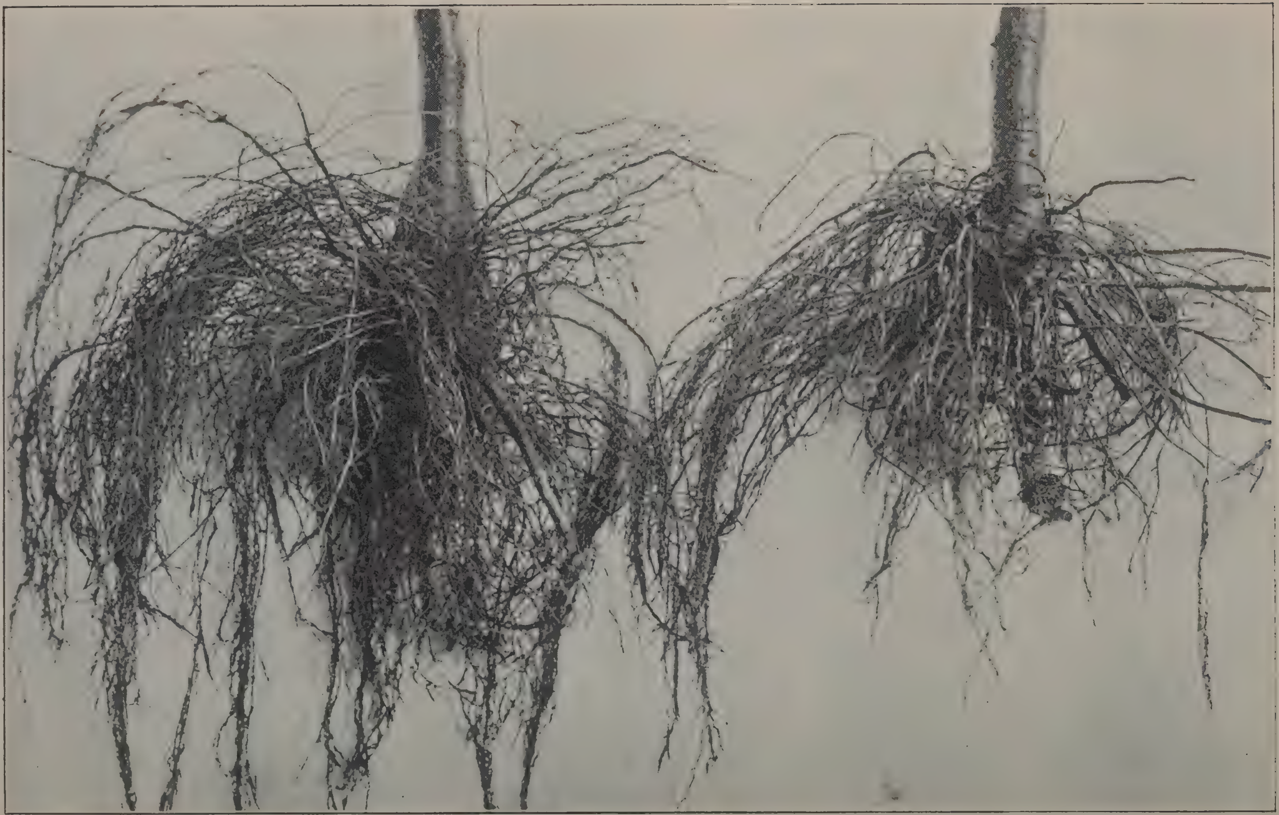


Plate III—Apple trees with crown gall, showing abnormal development of fibrous roots. (After Alwood.)

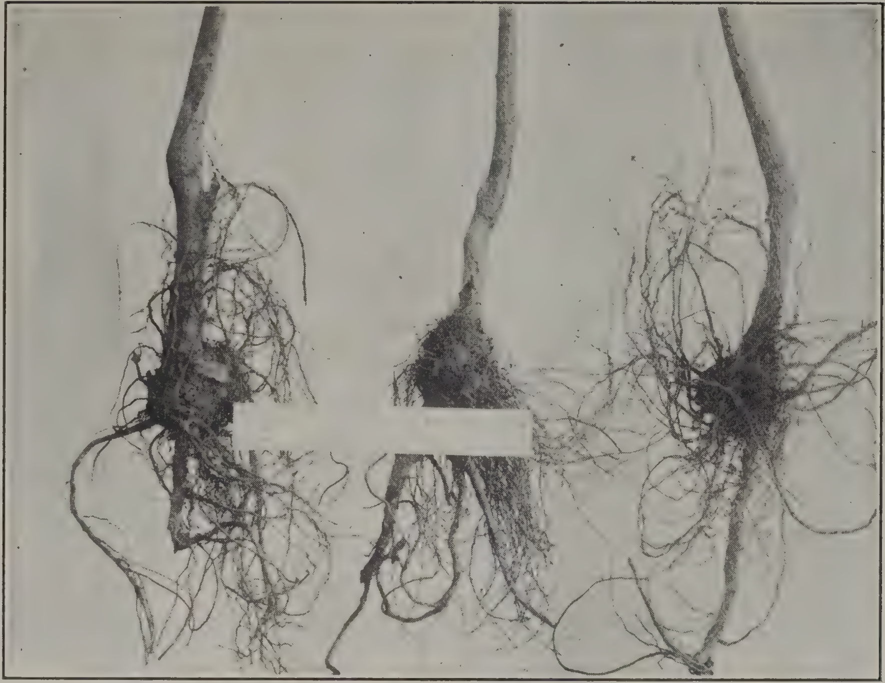
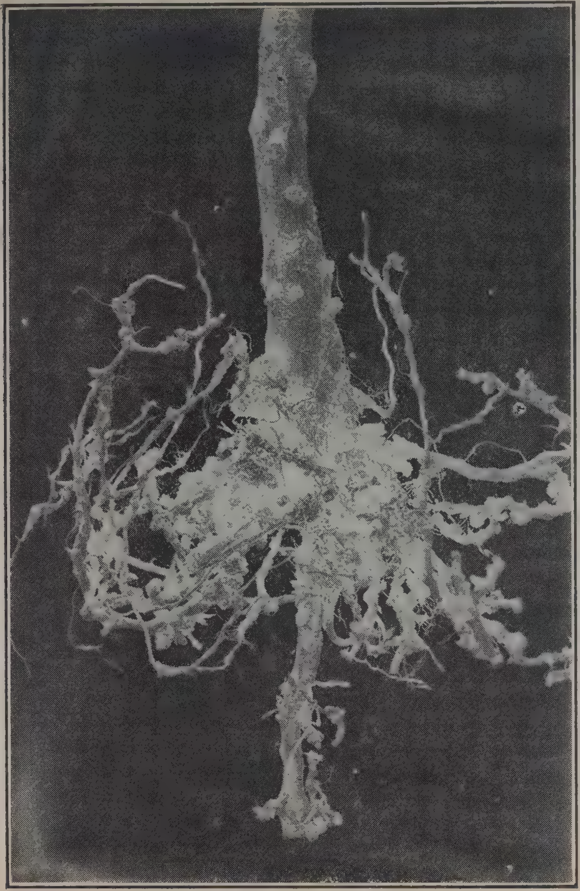


PLATE IV—Crown gall and hairy root of apple.



Root aphis effect on apple.

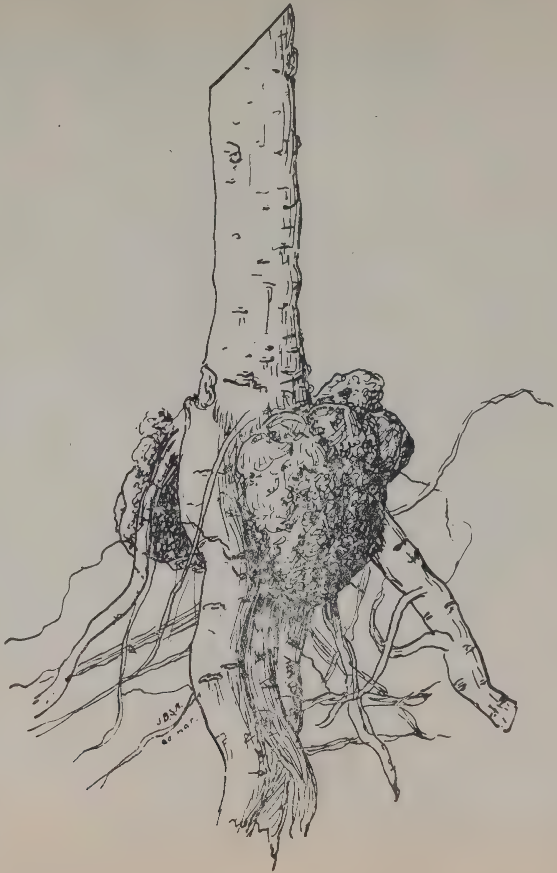


PLATE V—Crown gall on peach.

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THE MARYLAND
Agricultural Experiment Station
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 55. MARCH, 1904.

The Study of "Insects" in the Public Schools,

BY

T. B. SYMONS, Associate State Entomologist.

INTRODUCTION.

With a view to calling the attention of our worthy teachers to the great benefit and pleasure which may be derived both for themselves and their pupils by the introduction of the science of Entomology into the pupil's every day walks, and with the hope that it may contain some suggestions, which if put into effect, will enable the smallest school to have in its possession a good collection containing representatives of some of our most beautiful, and interesting forms of animal life, "insects," which will be an incentive to constant observation by the pupils, and illustrate to them some of the beauties of nature, this circular bulletin is issued.

While the science is correctly called Entomology, the word "Entomology" applies to a subject, and conveys to most minds the thought of its technical side, while the word "insects" applies to things, and is much simpler for the child to discuss. There is no doubt that we are constantly disregarding the well-known laws of the development of the child's mind, and the fact that in the growth of the intellectual faculties, the sense of perception must precede the formation of concepts, reasoning and judgment. While the laws of growth and development of all living things are practically the same, to the beginner, the difference between the members of the plant and animal kingdoms are so much more striking than their resemblances that representatives of each should be constantly brought to the attention of the pupil. In the attainment of this end, nothing will be found more profitable than the observation of the life and habits of insects.

In selecting representatives of these forms of animal life, the ease of obtaining and handling specimens, of keeping them alive, and watching their habits, are among the first important considerations. The abundance and convenient size of insects make it easy to study them. They can be found wherever man can live, and at all seasons. This abundance is even greater than is commonly supposed, when we remember that it is said that the insects alone comprise four-fifths of the animal kingdom. In addition, they have the advantage of presenting, while still retaining one general plan of structure, adaptations to almost all conceivable conditions of life. They live in the air, in the soil, on the water or beneath its surface. They feed upon plants or animals, as parasites either on the outside, or within the bodies of the latter ; often they devour their own kind and themselves serve as an important element in the food of many animals. They exhibit the highest stage of perfection yet obtained by animals in the transformation of chemical energy and can do more work in proportion to their size than any other animal.

The method of reproduction not only presents the ordinary sexual forms, either by the production of eggs or by giving forth living young ; but also the more unusual parthenogentic reproduction, or reproduction without fertilization. Further, nearly all insects in the course of their lives undergo remarkable changes in form. Thus the butterfly, which delights us with its airy flight, was at one time a caterpillar ; the bee, which goes so busily from flower to flower, lived first the life of a clumsy footless grub ; the graceful fly was developed from a maggot. These changes in their life history we denote as metamorphoses of insects.

Insects exhibit wonderful means of protection against their enemies, for animals of such small size. Claws, and still more effective stings supplied with poison, furnish them power of active defense. While others so closely resemble their surroundings in form and color that they deceive the sharpest eye. Some rely entirely for their safety on their extraordinary powers of locomotion by foot or wing.

Finally, the important relations of insects to man need only to be mentioned. For, while they are a great benefit to him in many ways, their activity in the destruction of his crops, or attacking his cattle or himself at times, causes him considerable apprehension.

Success in the study of insects will depend largely upon the skill displayed by the teacher or student in adapting the work to local conditions. Visit the forest, the orchard, the roadside and the pond, and the observant student will find much to attract his attention, especially the different forms of insect life inhabiting each. Everything possible should be done to make this study a recreation which the pupils will enjoy outside of school hours. Let each have his own collection. Do not discourage the pupils by requiring them to memorize abstract statements concerning insects, but cause them to develop the power of accurate observation and of careful comparison. This should be the real source of their information. The development of the habit of ascertaining facts for themselves is one of the greatest benefits the pupils will derive from the study

COLLECTING INSECTS.

While much can be learned by merely watching insects in the field, in order to study them thoroughly it is necessary to collect specimens. In doing this we should be as humane as possible. While there is no doub that insects are not so sensitive to pain as are higher animals, they certain ly suffer to some extent when injured. Therefore they should be handled with great care, and killed without inflicting needless pain. Here we have a lesson which the teacher can impress upon the young minds, that of not being cruel to animals. As stated elsewhere, insects can be found almost anywhere. The pupils can collect them while going to and from school or at recess, but a class should be excused for an hour or two to make longer trips and should be accompanied by the teacher. The ideal time for collecting insects is on warm days when the sun is shining.

Collecting Outfit. A collecting outfit should consist of a cyanide bottle, a net, a few small vials, some containing alcohol, and three or four pill boxes for bringing home live specimens. In collecting butterflies great care must be exercised not to rub the scales from the wings. It is a good plan to carry along folded papers or small envelopes in which you can put the insects after they have been killed and thus carry them to the laboratory without mutilation.

Killing or Cyanide Bottles. Many chemicals can be used in killing insects without causing them to suffer to any extent and without mutilating them. By saturating a piece of cotton with either chloroform or sulfuric ether, and enclosing it with the insect in a tight box or bottle the desired effect will be secured. But the most convenient and common method is by the use of a cyanide bottle. These bottles should be prepared by the teacher or a druggist. Too much care cannot be observed in the handling of this chemical as it is one of the most deadly poisons known

If it is used according to the following instructions, however, no fear need be entertained. There are many ways of making a cyanide bottle, but the simplest is to take a wide-mouthed bottle holding from four to six ounces. Put in the bottle one or two pieces of cyanide of potassium about ½ inch in diameter or one piece about ¾ inch in diameter. Now fill the bottle about a third full of fine sawdust and pack down as solid as possible. Cut a piece of stiff cardboard in a circle, the diameter equal to that of the inside of the bottle, and put a little mucilage on the under side. Place this on the sawdust pressing it down well. You now have a cyanide bottle, which if properly taken care of, will retain its strength for months. Never leave the stopper out of the bottle for any length of time. After making a cyanide bottle be sure to label it *poison.* Always advise the pupils as to the deadly character of the poison, so that they will never touch the cyanide. Fig. 1 shows a four ounce bottle made with sawdust and cyanide as indicated. Another method of making a cyanide bottle is, after putting into the bottle the amount of cyanide of potassium as stated above, to add water enough to cover the chemical and immediately put in enough plaster of Paris to soak up the water. In this way the cyanide will be more firmly cemented in place in the bottom of the bottle than in the first method mentioned. A cyanide bottle about one-fourth of the size of the one described above is useful to carry around in one's pocket constantly during the collecting season, see Fig. 2. Insects to be killed should be left in the bottle at least a half hour, but allowing them to remain longer, or even over night will not injure them.

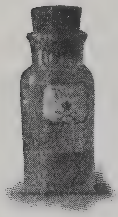

FIG. 1.

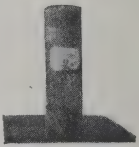

FIG. 2.

Insect Nets. While a net is not necessary to capture insects, it is advisable in order to catch a number of the members of the class which are strong jumpers or flyers. The form of net shown in Fig. 3 is usually employed. This can be made by taking a piece of No. 3 galvanized iron wire and bending into a ring about a foot in diameter. The ends of the wire should be twisted and tightly fastened to a light wooden handle such as is fitted to a broom. The ring should be covered with a strong piece of unbleached linen, and to this is sewed a bag made of strong cheese cloth, about two feet long, being the diameter of the ring, where it is sewed on, and tapering slightly towards the bottom. The bottom of the net should be rounded, and without corners or points in which the insects can lodge. This net can be used in catching insects flying in the air, and also those that rest on the grass, weeds, etc.

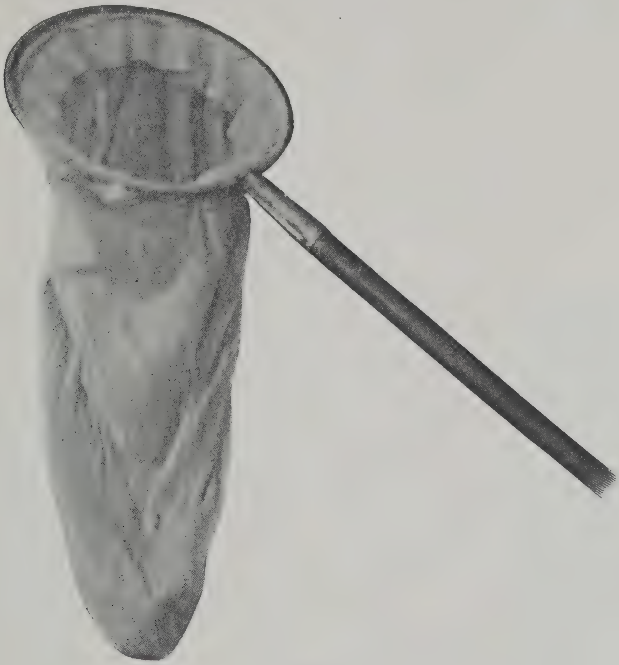

FIG. 3.

Vials and Pill Boxes. It is always well to have a few vials and pill boxes along on a collecting trip, in which you can place small, delicate insects alive or dead ; especially are they useful in carrying home living specimens of adults, pupæ or larvæ. In collecting soft-bodied insects and spiders it is best to have two or more vials filled with alcohol.

Paper Envelopes. This is what is referred to elsewhere in mentioning the manner in which lepidopterous insects may be carried. After killing the specimen by pinching the thorax, it is dropped into an envelope, such as a small drug envelope or the larger pay-roll envelope, which can be bought for a comparatively small sum at any stationers. In this way the insects can be carried in a small flat box without danger of breaking any of their parts. If the specimens are kept for any length of time in this manner they should be moistened by placing on damp sand before handling. It is hardly necessary to secure envelopes, however, if you can provide yourself with a very large cyanide jar prepared as the cyanide bottle, as the butterflies and moths can be put into the jar without danger of injury.

HOW TO COLLECT INSECTS.

With the above apparatus the collector can start out almost anywhere in the warm season of the year, and if on the alert he will see numbers of insects. One should go slowly, examining all herbage, foliage of shrubs and trees, and he will observe many tricks of the insects. He should use his net in catching active insects, but in collecting generally the net is also used for what is commonly called "sweeping." This consists in passing the net to and fro about two feet in front of you over the grass and herbage. The net must be turned at the end of each stroke, and must be kept in rapid motion so that the insects cannot escape from it. When a large number of specimens have accumulated in the net they should then be transferred to the cyanide bottle.

An excellent method of taking specimens at night is to open the window close to a light. In this way it will be found that many insects can be captured which one will never see during the daytime. The method known as "sugaring" is also practiced at times. This consists of smearing, with a solution, of paint consistency, made of molasses and stale beer, the trunks of trees on the edge of the woods or in a yard surrounding a house, or it may be applied anywhere to fences, that are likely to be surrounded by insects at night. The solution should be applied about sunset, on the places designated, in strips about two inches wide and several inches long. These patches of sweet solution will attract nocturnal insects, especially moths, and the collector can visit these baits after dark and there will be found hovering about them on the trees and fences many specimens which he can easily trap.

THE BREEDING OF SPECIMENS.

The best method of obtaining perfect specimens is by breeding them. Especially is this true with moths and butterflies. They do not have a chance to mutilate themselves, and also there is no danger of the collector's injuring any of their parts. Although breeding insects involves a good deal of labor and care, it affords a most delightful field for observation in the school, and the returns are frequently of great value. A point to be emphasized is, that in collecting insects and larvæ for the breeding cage one should observe the kind of food they eat when unmolested, as it is necessary to furnish them with an abundance of this food when they are confined. If they live in water, determine whether they will require running water or can be kept in an ordinary aquarium.

The boxes, suggested as a part of the collector's apparatus, are used principally to carry such specimens as he wishes to keep alive in the school or laboratory.

Breeding Cages. There are a great many kinds of breeding cages, but it is only necessary to cite the simplest in this discussion. This is represented in Fig. 4. It is made by combining a flower pot and a lantern globe. If convenient, the food plant can be planted in the pot ; or, if not, a small tin or bottle filled with water may be placed in the earth and the stems or other material can be kept fresh for a time by keeping the lower ends in water. The top of the globe should be covered with fine mosquito netting which can be held in place by either a string or a rubber band. Of course larger pots and correspondingly large glass cylinders as represented in Fig. 5 may be used. These pots are readily moved from place to place and are especially convenient for watching the insects confined.

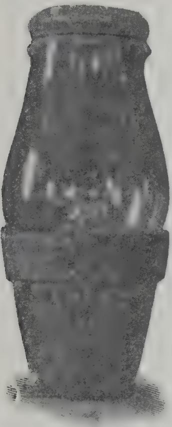
FIG. 4.

FIG. 5.

Aquaria. For keeping and breeding aquatic insects some form of an aquarium is needed, but it need not necessarily contain running water. Of course, if such is convenient, it is very desirable. Any ordinary jar can be used. It is a good plan to keep some kind of water plants in the jar, as the water will be kept in a better condition and it will not be necessary to change it so often.

THE PRESERVATION OF SPECIMENS.

After a collecting trip, specimens collected should be mounted immediately, as they can be handled more easily then than at any other time. All insects that will preserve their forms when dry should be pinned, with specimens of their nests or work, mined or rolled leaves, or other similar objects. Immature forms of all insects, adult insects which have soft bodies, or specimens intended for anatomical study, should be preserved in alcohol or some other preserving fluid. Some insects of minute size should be mounted in Canada balsam upon slides.

Insect Pins. There are many styles of insect pins employed, but those used generally by American entomologists are known as German pins. They are rather long and slender, and are preferred for this reason, as they keep the specimen higher from the bottom of the box than ordinary pins. It is also desirable to use these pins ; for if shorter ones are used, and at any time one should wish to change specimens, some difficulty would arise on account of the difference in the size of the pins. These German pins are made in different sizes of wire and are numbered accordingly. It is left to the judgment of the collector what size to use for the different sized insects. They can be purchased from any establishment dealing in entomological supplies. If it is not possible for the teacher to secure these pins, the common brass pins which are somewhat thicker and shorter can be used. The ordinary mourning pins have better points than the common brass pins and may be preferable for this purpose, especially when cork or pith is not used in insect cases.

Pinning Specimens. In a properly arranged collection it is of prime importance in pinning specimens to have them uniform both as to the position of the insect on the pin, and also the place of inserting the pin through the insect. A good rule to remember in pinning most insects, is to project the pin through the middle of the thorax of the insect. There are exceptions to this rule, however, especially in the case of beetles, which should be pinned through the right wing cover, at about one fourth of its length from the base as shown in Fig. 6, and also in pinning what we may call bugs (order *Hemiptera*), which should be pinned through the scutellum, the triangular plate on the back.

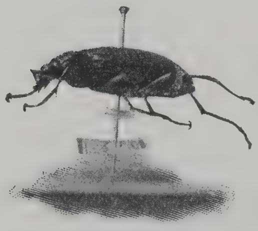

FIG. 6.

In order to secure uniformity in the position of insects on the pins, a device shown in Fig. 7 is convenient. This consists of three small strips of wood one fourth as thick as the pins are long and fastened together as shown. A hole just large enough to allow the passage of the head of the insect pin in use is bored through the center of each step of the block. In pinning an insect, the pin is pushed through the insect so that less than one fourth of its length projects above it, and the insect is pushed back into the proper place by inserting the head of the pin in the hole in the lower step of the block. This step and the second is used in fixing the height of insects mounted on cardboard tips.

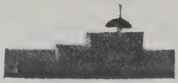

Fig. 7.

When it is wished to pin an insect which is too small to pass a pin through and which is not desired mounted on glass slides, the insect may be stuck, by means of a small amount of muscilage, to pointed pieces of cardboard as shown in Fig. 8.

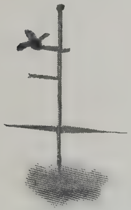

Fig. 8.

Much more attention is necessary in pinning the members of the order *Lepidoptera*, or moths and butterflies, than other insects. As stated elsewhere care must be exercised in handling them so as not to rub the scales off their wings. After the pin has been thrust perpendicularly through the thorax, the insect should then be placed in a setting board. Setting boards are pieces of wood having a groove on the upper surface of sufficient depth to accommodate the body of the insect and to permit its wings to be brought on a level with the upper surface of the board as shown in Fig. 9. On the bottom of the groove should be tacked a piece of cork or pith into which the pin inserted through the insect may be thrust down below its body for a considerable distance, to hold it steady. There should be uniformity in arranging the wings. After the wings are put in position and held there by narrow slips of paper, wider slips of paper or mica are laid on the wings and pinned down. For this purpose sharp pointed mourning pins are better than the ordinary brass pins. In pinning down the slips of paper or mica which are to hold the wings

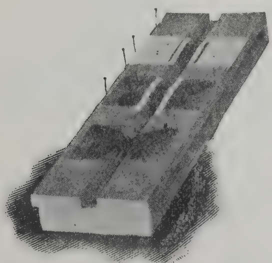

Fig. 9.

in place, be careful to pin around the wing, but never, if possible, through it. The specimens should be left in this manner for from three to six days, or until the wings will hold their positions when the mica or paper is removed. The wings of other insects may be spread in the same manner.

Inflating Larvæ. While the larvæ of insects are usually preserved in alcohol, it is often wished to pin the specimen in the regular collection with the adult. In order to do this the larvæ must be inflated so that it will not decay. In inflating the larvæ the first step, after killing it in a cyanide bottle, is carefully to remove the contents of the skin. This is done by inserting a stout pin or needle into the anal extremity. Lay the specimen on a sheet of paper, and, placing a pencil across it just back of its head, press out the contents of the abdominal cavity. Care must be exercised to apply only enough pressure to expel the contents of the skin without mutilating any of the tissues which lie nearest to the epidermis, or the hairs which may be attached to the body. Now insert a straw, or glass tube, previously heated, in the anal opening and close the opening perfectly with glue or colodium if necessary, and inflate, hold it while inflated in a hot place to dry. A convenient method of drying it is in an oven made by laying a large lamp chimney across a tray of sand over a lamp. (See Fig. 10.) Hold the specimen in the heat until thoroughly dry, but in drying the skin care must be exercised not to heat it so much as to destroy the colors. When the skin is dry remove it from the tube and mount it on a piece of copper wire, wrapped in green silk, which has been bent around a small piece of cork, through which insert an insect pin. The wires are bent and twisted together for a short distance and then made to diverge as shown in Fig. 11. An inflated larvæ mounted is illustrated in Fig. 12.

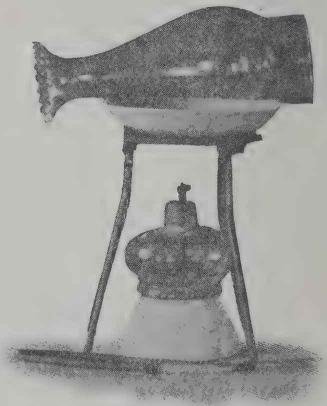

Fig. 10.

Labeling Specimens. It is very important in making a collection of insects, to label carefully each specimen, so that it will be possible at any time to tell when and where each one was collected. Moreover, if there is any other data of observation made concerning the insect, it should be recorded in such a way that there can be no doubt of the specimen to which it refers. While it is not practical to give each specimen a different number, you can give each species a different number. The label shown in Fig. 13, we find to be useful and practical. On these are shown the location, the date of collecting specimen and the accession number. This accession number refers to an accession book in which there are corresponding numbers and in which is written such data as is obtained concerning the specimens. These lables can be printed at a small expense, or they can be written; but it is best to have them as small as possible. Another label containing the generic and specific name of the insect should be attached to each specimen. In arranging specimens in a permanent collection, labels should be placed at the head of each group indica-

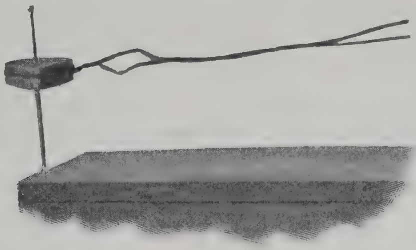

Fig. 11.

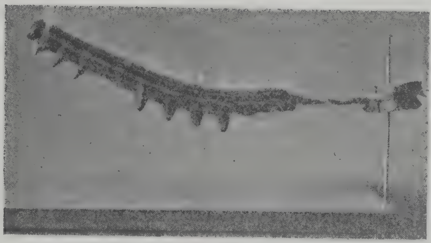

Fig. 12.

College Park, Md.	Md.
190	190
Acc. No.	Acc. No.
College Park, Md.	Md.
190	190
Acc. No.	Acc. No.
College Park, Md.	Md.
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Acc. No.	Acc. No.
College Park, Md.	Md.
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Acc. No.	Acc. No.
College Park, Md.	Md.
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Acc. No.	Acc. No.
College Park, Md.	Md.
190	190
Acc. No.	Acc. No.

Fig. 13.

ting the order, family and genus. The size of the labels generally used for each respective classification is shown in Fig. 14. The labels are generally printed in red ink. This will not only add to the appearance of the collection but will be useful in looking up any particular specimen.

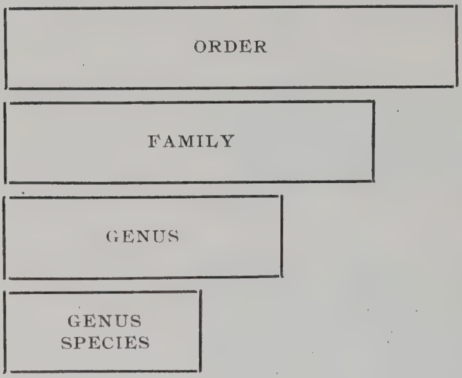

Fig. 14.

Insect Cases. It will not be practical to discuss the many forms of insect cases employed. It is left to the teacher to select the one that is best suited to his needs. But it should be borne in mind that an insect case should be tight so as to exclude insects which may prey upon their kind. A small beetle "the museum pest," if it gain access to a collection, will destroy many mounted specimens in a short time. If this pest should appear, its work being detected by the small amount of dust under each specimen, or by examining the specimens closely and observing that they are being mutilated, the case should at once be fumigated with carbon bisulphide by pouring a small amount of the liquid in a watch glass or other small vessel and placing this in the case, and keep the latter closed for several hours. By continuing this practice the pest will be eradicated. For temporary use, and especially when it is desirable to avoid unnecessary expense, cigar boxes can be procured in which the insects can be pinned. Although these are convenient to use, if a teacher or pupil desires to make a permanent collection, some kind of insect case should be employed for the reason given above. A case such as is shown in Fig. 15 is very convenient at times. It is about 12 inches long, 9¼ inches wide, and 3⅝ inches thick, made as illustrated in cut, so it will close tightly. A case of this character will hold a large number of insects as they can be pinned in both top and

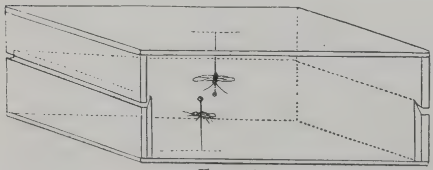

Fig. 15.

bottom as shown. Thin cork, which is covered over with paper, is placed in both top and bottom in which the pins may be projected.

The methods of collecting and preserving insects given in this circular are recommended by Prof. J. H. Comstock, one of our leading entomologists, in his book entitled "Insect Life," which, with Comstock's "Manual of Insects," the writer commends to every teacher and pupil working with these interesting forms of animal life.

Any specimens sent to the Entomological Department, Maryland Agricultural College, College Park, Maryland, will be gladly determined and any information desired will be given. It is our wish that each school in time may have a permanent collection of insects.

It is to be hoped that the instructors in our public schools will foster this science, which will not only afford pleasure to the pupils, but will train their power of observation and develop a love of nature.

To the Teachers of Maryland:

We are sending out at this time three pamphlets bearing upon nature study. We trust that these little messengers of our good will will find you deeply interested in the work. Certainly efforts expended, in equipping the young with the means of finding an intellectual interest in future surroundings, must be most gratifying to those who lend themselves to the task. If you are a teacher in a rural school are you not astounded at the ignorance of the children of the simple effects and causes which are constantly operating around them? How different each day would be in its quantum of pleasure, if the eyes could see, if the ears could hear and the mind could understand that hidden in everything that exists is the principal that vitalizes its being. Seeing and knowing these principles lifts life above drudgery and makes any calling a pleasant vocation. Now our mission is to give our pupils just this power. Could our task be a nobler one? We wish to lend you all the instrumentalities of this institution to the accomplishment of this one end. Will you not accept them and thus aid in the great work which is arousing so much interest in every part of our country? We believe that you will.

Fraternally yours,

R. W. SILVESTER,

President of the Maryland Agricultural College.

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THE MARYLAND
Agricultural Experiment Station
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 54. DECEMBER, 1903.

HOW TO TREAT THE SAN JOSE SCALE.

By T. B. SYMONS,
Associate State Entomologist.

Without a doubt there are many orchardists in the State who have not as yet controlled the San Jose scale, and this circular is prepared as a preliminary report stating what we find from our experiments to be the best and most efficient treatment for this pernicious pest.

GENERAL REMARKS.

Reports from our local inspectors and from our personal visits all over the State show undoubtedly that the orchardists in the State will have to continue the fight against the San Jose scale with more vigor than ever in order to protect their interests. The presence of the scale in many orchards in the State will necessitate much careful spraying in order to protect the amount invested in orchards, not taking into account the great inconvenience of being without fruit. While we cannot expect to eradicate the scale, we can safely say that it can be controlled to the extent of reducing its ravages to a minimum. But it must be remembered that this end cannot be accomplished without some expense and trouble.

It is of prime importance that orchardists keep an eye on their orchards and often examine the twigs and branches of the trees so that if it should become infested they will be able to take it in hand before it does any appreciable damage. Where infested trees have been found here and there in an orchard, the scale is in all probability much more generally distributed than an inspection would ordinarily indicate. Under these circumstances the whole orchard should be sprayed. Any signs of failing vigor or unnatural appearance of the bark, should at once call for a close inspection. In this way serious loss may frequently be prevented by detecting the presence of injurious insects or diseases as soon as possible after their establishment in the orchard. When you are in doubt of the trouble send some specimens at once to this office, and the matter will be given immediate attention.

LIME, SULFUR AND SALT WASH.

As stated above this circular is a preliminary announcement of the results from experiments which show conclusively that in the average sized orchard, the lime, sulfur and salt wash is superior to all others as regards cost and effectiveness in controlling the San Jose scale. The wash is also beneficial against many fungous diseases, especially peach leaf curl.

WHEN IT SHOULD BE APPLIED.

Heretofore it was considered that this wash should only be applied in the early spring, but from the results of our experiments we find that it can be applied in the fall with a degree of effectiveness. Badly infested orchards should receive two applications, one in the fall after the trees loose their leaves and one in the spring just before the buds begin to swell. But if only one treatment can be applied we find applying the

HOW THE WASH IS MADE ON A LARGE PLAN (after Fisher).

wash in the spring to be the most effective. It must be remembered, however, that this wash should only be applied when the trees are in a dormant condition.

PREPARATION.

Various amounts of these substances have been used in different proportions and combined in different ways, but we find from our experiments the normal lime, sulfur and salt wash made according to the following formula to be the most satisfactory so far:

Fresh Stone Lime, 30 pounds.
Flowers of Sulfur, 16 pounds.
Common Salt, 12 pounds.
Water to make 50 gallons.

Directions—Thoroughly slack 15 pounds of lime with warm water and add all of the sulfur and enough water to make the whole measure about 15 to 20 gallons. Boil briskly in an iron pot or hog scalder, (if making on a large scale place the materials in a barrel and boil by steam), for at least three-quarters of an hour or until the sulfur is thoroughly dissolved, producing a clear amber colored solution. The mixture should be kept well stirred while boiling, as the sulfur may form lumps which must be crushed against the sides of the vessel. In the meanwhile slack the remaining 15 pounds of lime producing a smooth paste or cream of lime, and while it is slacking add the 12 pounds of salt. When this is dissolved add to the first solution (lime and sulfur) and boil for half an hour longer. Now add hot water to make the 50 gallons. Carefully strain through a strainer, having about 20 meshes to the inch, as it is poured into the spray-barrel and apply warm.

As stated above there are many methods of combining these materials and in our experiments we have employed various ways of preparation. The method of throwing all the materials into the pot or barrel at once, appears to have given good results, nearly equal to those given in making the wash in the usual manner. We have also had good reports from those who have used a smaller quantity of lime, say 20 pounds instead of 30 pounds. We do not recommend applying the wash cold as upon cooling a large amount of sediment is formed which will clog the pump and also lessen the effectiveness of the wash. While some recommend after boiling all the materials in say 15 or 20 gallons of water they make up the given amount by adding cold water. This may give good results but we prefer adding warm water. The wash made with lime and sulfur has also given good results, but again, we think that the salt aids in causing the mixture to stick to the tree longer.

MODE OF APPLICATION.

Any pump that has all the working parts brass and furnishes a constant high pressure may be used, and in general a nozzle that is satisfactory for the application of Bordeaux mixture will also be suitable for the lime, sulfur and salt wash. The "Pomona," "Eclipse" or "Century" barrel-sprayers will be found suitable for the work. Always clean the pump thoroughly after using, by washing out with clear water. The hose and pump are very readily injured if the mixture is allowed to stand in them for any length of time. Owing to the fact that the wash is somewhat disagreeable to use, the sprayman should provide himself with a rubber or oilskin coat, hat and gloves, and many have found a pair of goggles, with clear glasses, very useful. It is also a good plan to throw a blanket or sack over the horses. The mode of application does not differ in the case of this wash from that of any other spray materials. The main point to be observed is, to be very careful that all parts of the tree are treated. It is of advantage to have the hose of sufficent length to enable the sprayer to encircle the tree and finish it before leaving. Upon drying, the treated trees present a whitened appearance very much as if whitewashed and it is then very easy to detect any parts that have not been treated. It is also a good plan before spraying to head the trees back as it is difficult to apply the wash on the terminal twigs. This is generally not only beneficial to many classes of fruit trees, but adds much to the beneficial results from the use of the wash. Where trees are very badly infested and some of the terminal twigs dead they should be severely cut back, as this will save a quantity of the wash and will enable the trees to form a new top.

In conclusion it is to be hoped that the orchardists who have not controlled the San Jose scale, will give it their immediate attention and apply a remedy which will reduce its ravages to a minimum.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION

STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 53. MAY, 1903.

DIGEST OF STATE LAWS RELATING TO THE CONTROL OF INSECTS AND PLANT DISEASES.

Compiled by J. B. S. Norton and Frederick H. Blodgett.

ALABAMA.

State Board of Horticulture created (Commissioner of Agriculture and Industries, chairman, President State Horticultural Society, and Director Experiment Station) with power to enact rules for inspection, etc. State Horticulturist is secretary to board and executive officer of law—as chief inspector—who shall make quarterly reports on work and expenditure to Board, which shall make annual report to Governor. $1.500 allowed.

Under rules adopted seven insects and diseases specified as dangerous, and prevent granting of certificates until removed or treated. Certificates to terminate July 15th, annually. Nurseries to be examined between July 15th and November 15th, annually. Other provisions detail usual provisions in respect to use of certificates on all shipments, fines for violations, right of entry, etc.

ARIZONA.

(No Law.)

ARKANSAS.

(No Law).

CALIFORNIA.

State Board of Horticulture.

The State Board of Horticulture consists of nine members, appointed by the Governor, from districts defined; serve four years; must have special horticultural experience, and their duty to promote horticultural interests and disseminate instruction in horticulture.

State Board makes regulations for preventing spread of diseases, etc., which, when published twenty days in State papers, and conspicuously posted in each county, are binding on all persons.

The Board also elects Secretary and Clerk of Publishing and Quarantine Bureau from without their number. The latter has power to enforce State regulations and quarantine infected places.

The State Board, or in its recess, said clerk may appoint quarantine guardians, or a deputy, in a case of emergency to enforce State regulations. Salary of quarantine guardian, $3.00 per day, to be paid by owners under quarantine, and may be collected before a justice of the peace.

Board shall report annually to Legislature, and receive traveling expenses only in attending meetings.

On application of one or more fruit growers the Board shall select such persons to make experiments in their districts, and pay expenses of same.

County Board of Horticulture.

On petition to supervisors of any county by twenty-five or more freeholding orchardists, stating certain orchards, nurseries or trees to be infested with destructive insects, they shall appoint in twenty days a board of horticultural commissioners of three members, who may be removed by a similar petition.

Said Board shall report quarterly to State Board.

Said Board shall, when they deem it necessary, inspect anything in their jurisdiction; if found infested, shall notify owner to eradicate pests in same in a specified time, notice to be served in person by a commissioner or deputy as a summons in civil action. Such infested places are declared a nuisance. If on account of non-residence, or otherwise, notice cannot be served; the Board is given power to abate such nuisance in a summary manner, expenses of same to become a county lien on such premises.

State Board may divide county into districts, and appoint local inspectors to hold office at its pleasure for each district. State Board may commission as quarantine guardians two members of county board or local inspectors thereof. Salary of inspectors, $2.50 per day; traveling expenses, $4.00 per day, when in service, paid by county commissioners.

Horticultural Quarantine Law.

Importers of nursery stock shall notify quarantine guardian of their district or county of the arrival of such stock, and hold same for their immediate inspection, and said quarantine officers are given power to enter any place for making an examination of such nursery stock.

Each importation of nursery stock must be plainly marked with addresses of consignor and consignee, and place where stock was grown.

Any such shipment, if infested or infected, shall be disinfected at the owner's expense in a manner specified by quarantine officer, and then released; or if infested with insects not found in this State, it shall be immediately sent out or destroyed at option of owner, and at his expense.

COLORADO.

County Commissioners shall, upon petition of thirty-five orchard owners, appoint county inspector for one year, at $4.00 per day, and deputies at $2,50 per day, for services rendered.

Professor of Entomology at State College to examine all appointees, and grant license to competent applicants. License confers power and authority as inspector on holder. Each inspector shall give bond. and may appoint deputies on approval of County Commissioners.

Complete records of work shall be kept; quarantine stations are provided for, and the further provisions of the law are essentially similar to the Montana, Idaho, Washington and Oregon laws, except that containing packages of fruits or of stock (boxes, etc.) are not mentioned as nuisances after use. Counties to meet expenses of inspections within their own limits.

Spraying in bloom with any substance injurious to trees prohibited.

CONNECTICUT.

Board of Control of Experiment Station to appoint State Entomologist to serve during pleasure of board, who shall receive salary as station officer only. He may appoint three deputies, and shall inspect any property on request or on suspicion. May issue bulletins of information, conduct experiments, purchase apparatus, and employ assistants, and make annual report of work and expenses.

All shipments into State are to have certificates, and all nurseries in State shall be inspected and certified. Usual penalties are provided, power of entry granted, and three thousand dollars are appropriated.

DELAWARE.

Differs as follows from Maryland law: The Governor shall appoint three Commissioners of Agriculture, forming the State Board of Agriculture, meeting at least once in three months. Power granted to abate, suppress, eradicate and prevent San Jose scale, peach yellows, pear blight, and all other injuriously dangerous diseases of plants or farm animals, etc., and to employ and discharge inspectors, etc., at discretion, make rules for governing inspectors, etc., employed by Board. All wages and expenses must be met by appropriation for each year.

Owners neglecting to comply with orders of Board shall be guilty of misdemeanor. Fine shall be not less than double the amount of expenses of Board and cost of suit. Board shall warn farmers and other persons of the existence and location of new and dangerous insects and diseases, with any remedies for same. Board shall inspect at least once every year all nurseries. Absence of certificate punishable by twenty-five dollars fine.

Importations of nursery stock must bear certificate of inspection. No uncertified stock shall be delivered, but deemed a public nuisance, which shall be abated by trial in a justice's court. When free, shall be certified by inspector to justice of peace; otherwise that stock shall be totally consumed by fire, with no recovery of damages for loss.

Purchasers of infested stock shall not be liable for payment, and may recover if already paid. Such stock to be destroyed.

Board shall make annual report of work of inspectors. Moneys appropriated, and fines collected, paid to President of Board, who shall be bonded at $3,000, and used for Board's expenses.

Board shall have power to compel growers to place marks of identification on all fruit packages. Fine for refusal to comply, five dollars.

Members of Board guilty of neglect of duty shall be fined twenty-five to fifty dollars and cost for each offense.

FLORIDA.

(No Law).

GEORGIA.

State Board of Entomology, consisting of State Commissioner of Agriculture, President of State Horticultural Society, and President of State Agricultural Society, shall have power to enact such rules, regulations governing inspections, certification, sale, transportation and introduction of nursery stock as they deem necessary to control insect pests and plant diseases.

State Entomologist shall be inspector under direction of Board; salary and expenses provided for. He shall determine whether infested plants shall be treated or destroyed, and shall report in writing to owner and to Board. Board may act as court of appeals.

Treatment prescribed by inspector shall be executed at once, unless appealed within three days to the Board, and expenses borne by owner. No compensation for plants destroyed. Refusal by owner shall be enforced by county judge or ordinary. Expenses and cost to be borne by owner. It is a misdemeanor to dispose of trees or plants infested with injurious insects or plant diseases, or to ship into State not certified. Hindering discharge of duties of inspector or agents is misdemeanor. Georgia nurserymen shall have stock inspected each year before November 1st. Shipment before filing certificate of inspection is a misdemeanor. Infestation to be defined by Board, and published in State press.

Outside nurserymen shall file copies of inspection certificate when doing business in the State, or their shipments are liable to confiscation.

On request of two citizens, inspector shall personally investigate instance of noxious insects or diseases in any county. Shall prescribe treatment for infested plants, and if same is not given in ten days, shall direct further treatment or destroy plants, cost to be met by owner.

The inspector shall make monthly report of work and expenses.

IDAHO.

State Board of Horticultural Inspection created—Director of Experiment Station, Professor of Zoology at State University, with three others appointed by Governor for three years, one new member each year on recommendation of State Horticultural Society. All members shall subscribe to official oath. Board shall elect a President and a Secretary, the latter to receive a salary not exceeding $350 per year. Board to meet annually.

Board to appoint State Horticultural Inspector, who shall receive at least $900. The State shall be divided into not over ten districts, a deputy inspector to be appointed for each to hold office during the pleasure of Board. Each deputy shall have practical knowledge of horticulture and of the pests incident thereto. Their jurisdiction confined to respective districts. State Inspector jurisdiction over whole State. Board shall estimate funds available for each district annually and inspectors must not exceed estimate.

Each inspector shall receive $5.00 for each day actually employed, which shall be drawn in a prescribed manner from the State funds. Duty of inspectors of themselves or on complaint to enter and inspect any premises suspected of infestation with pests or fungi; if such are found, inspector shall notify owner or person in charge, and require him to treat the infested plants within a specified time. Notice may be in person, or in writing, or as a court summons. Neglect or failure of owner to comply with directions given renders the infested place or plants a public nuisance. District Inspectors or State Inspector is empowered to abate such nuisance by destroying or treating infested places or plants. Expenses to be paid from State funds, recoverable by civil suit under County attorney against owners of real estate infested, sums so recovered to go into Treasury.

Authority to enforce quarantine against infested places when there is danger of contagious diseases spreading from them.

All dealers in nursery stock must make application, accompanied by approved bond for $1,000—guaranteeing compliance with this law, to State Board of Horticultural Inspection. Upon approval of application and bond, Board shall issue certificate to nurserymen, which is in nature a license to do business in Idaho.

All imported nursery stock shall be fumigated before sale, unless accompanied by certificate of previous fumigation.

Selling without certificate (license), permitting sales, or failure to notify inspectors of importation of stock, refusal to treat stock, or neglect or refusal to comply with rules or orders of Inspector, is a misdemeanor—fine, twenty-five to three hundred dollars.

Stone fruits growing in a district infested with "yellows" or "rosette" are prohibited from distribution or transportation in any manner whatever; such stock shall be burned without delay when required by inspector.

Foreign-grown stock shall not be sold, except after inspection by State or District Inspector, owner to pay the expenses incurred.

Shippers into State shall plainly mark all packages of stock, showing grower's place, where grown, kind and quality of stock.

Detailed reports of work and expenses shall be rendered monthly by each District Inspector to Secretary of Board. Bills incurred shall be approved by majority of Board and then paid as other State bills.

Members of Board only receive expenses incurred in attending meetings. Bonds required of county officers for any duties imposed by this law.

ILLINOIS.

State Entomologist shall inspect, or have inspected, all nurseries in the State, and if apparently free from dangerous insects and contagious plant diseases, shall give certificate, duplicates to be filed with Experiment Station and Secretary of Horticultural Society.

All sales or delivery of nursery stock to be accompanied by proper certificate. Fine for wrong use of certificate, fifty to one hundred dollars. Trial before justice, attorney to prosecute; fines go into State Treasury.

State Entomologist shall inspect, or have inspected, places where insects or diseases are suspected. He has power to enter any place during reasonable business hours. Owner or person in charge to be notified in writing when insects or diseases are found, with directions for treatment. Persons refusing to comply shall meet one-half the expenses of said treatment, to be made by Entomologist. Property infested before 1899 shall be treated without cost to owner, or may be destroyed without compensation to owner. Clean properties shall be certified (1899) without cost.

Shipments into the State must be certified or held by transportation agents, and Entomologist notified within twenty-four hours, and not delivered until certificate granted. Certified shipments shall be accepted, but are subject to inspection at the judgment of Entomologist, as if grown in the State.

Violation, neglect or hindrance in carrying out the provisions of the law subject to fine from ten to one hundred dollars and costs in justice's court.

Office of State Entomologist to be at the University of Illinois, where he is to be provided with room. Entomologist shall appoint assistants, fix their compensation, and their acts shall have same force as his own.

He shall make required reports to Governor, State Horticultural Society and State Auditor of his expenses, operations and detail of inspection work, including property destroyed. Eight thousand dollars appropriated for two years.

INDIANA.

Governor appoints State Entomologist for four years. His duty to inspect nursery stock and other plants, and has power to enter premises for this purpose.

All Indiana nurseries to be inspected between June 1st and October 1st, each year, by said Entomologist, who shall notify owner, Secretary State Board of Agriculutre, Director of Experiment Station, and President of the State Horticultural Society of the presence of destructively-injurious insects or fungi, and shall require owner to take remedial measures within specified time. Clean stock shall be certified to, and duplicates filed with the above officers, and same to be open to public.

Owner shall destroy pests as directed. Fine for shipping or delivering infested stock, twenty-five dollars, recoverable before justice or grand jury of county where grown or shipped to.

All shipments must have proper certificate—fine, twenty-five dollars. Shipments into State must be certified. If not, to be held, State Entomologist notified, and stock inspected and passed or destroyed. Violation by transportation agents subject to twenty-five to one hundred dollars fine and cost, or imprisonment. Fines go into State Treasury.

Owners may request inspection of their property, and shall be given certificate or treatment directed as conditions warrant. Failure to treat punishable ten to twenty-five dollars fine and costs, subject to appeal within three days to Circuit Court, whose decision is final.

One thousand dollars annual appropriation for Entomologist, who shall report his expenses to Governor.

IOWA.

Entomologist of Experiment Station is State Entomologist, and charged with execution of this act. May appoint and fix compensation of assistants. He shall examine, when requested by owner, or when deemed necessary, all nurseries, between June 1st and September 15th, each year. If free from scale, shall issue certificate, and collect fee of $5.00 to $15.00.

Unlawful to transport stock out of county where grown without a certificate. Power given to Entomologist and assistants to enter on premises where scale is suspected, and prescribe quarantine regulations. If treatment is practicable, shall prescribe same in writing. If not, order infested plants burned. Failure to obey orders shall authorize Entomologist to execute them, and expense shall be collected as a tax on owner.

Nursery stock may be shipped into State with certificate, but if believed to be infested may be treated as above prescribed. If not certified, importer shall be subject to fine of from ten to one hundred dollars and costs. All fines to be added to inspection fund.

KANSAS.

(No Law).

KENTUCKY.

Entomologist and Botanist of Experiment Station is State Entomologist, to serve without extra pay, but expenses to be met by appropriation.

State Entomologist shall inspect all nurseries in Kentucky, "at such time as he may elect," each year, and shall notify owner, Commissioner of Agriculture, Director of Experiment Station, President of State Horticultural Society of the presence of insects or fungi; and shall direct owner in writing to take remedial measures within certain time. Owner shall effectively treat his stock within time given, or be fined fifty dollars for each failure, before justice of peace or grand jury of county where grown, or to which shipped.

All shipments within State must be accompanied by proper certificates. Failure or fraudulent use renders shipper liable to fine of fifty dollars for every such shipment.

Shipments into State shall be certified, or be held by transportation agent until inspected and passed by State Entomologist. If condemned, or if not inspected, shipment shall be destroyed or returned to consignor.

All clean stock shall be certified by State Entomologist, and copies shall be filed with Commissioner of Agriculture and Statistics, and with President Agricultural College, and shall be open to public.

Owners may and shall request inspection of their property when they suspect presence of dangerous insects or fungi, and State Entomologist shall make inspection and recommend needed treatment.

Five hundred dollars appropriated for expenses to be reported to Treasurer by State Entomologist annually.

Special Black-Knot Law.

Black-Knot declared a public nuisance, and no damages recoverable for destruction of trees or parts of trees under law. Three resident free-holders, who are fruit growers, shall be appointed commissioners by county judge, on petition of three or more resident free-holders; Commissioner shall inspect infected trees, and mark such parts as should be removed. Notice to owner to remove such marked parts or trees to be signed by two or all the commissioners. The commissioners shall destroy by fire the trees or parts of trees previously marked, when owner fails to do so. Failure on part of owner punishable by fine not over $25.00, or not over ten days in jail, or both, in discretion of justice of peace. Fines recoverable into county treasury. Commissioners and their agents shall have right to enter any and all premises within their county. They shall be allowed $2.00 per day, $1.00 per half day, and expenses. Expenses to be recovered by county from owners of diseased trees destroyed.

Mayors of cities of first and second class shall act as commissioners for such cities.

LOUISIANA.

Unlawful to import, or sell, or distribute plants infected with injurious insects or diseases.

Imported plants must be properly labelled, and subject to inspection by Entomologist of Experiment Station.

State Entomologist shall visit any part of the State where there are affected trees, when it can be done without expense to the Sate, and examine and report on the same. If perniciously affected, owner shall disinfect or destroy same; penalty for neglect, five to one hundred dollars fine or imprisonment.

Enforcement laid on district attorney on complaint of stated parties. Fines, after deduction of fees, go to Experiment Station for the inspection fund.

MAINE.

Nursery stock shipped in must bear certificate of inspection. Brought in without such, shall be returned to consignor at his expense. Shipments exempt if affidavit of proper fumigation is attached.

Transporters carrying uncertified stock subject to one hundred dollars fine.

If any one suspects the presence of San Jose scale or other injurious insects or diseases on trees, etc., they shall notify Commissioner of Agriculture, who shall have them inspected by competent entomologists. If scale is found, Commissioner shall publish report of same, and apply best-known remedy. Commissioner or his employees given power to treat as above. The Commissioner of Agriculture shall enforce the penalties for violation of this Act.

MARYLAND.

State Horticultural Department created, Professors of Entomology, Vegetable Pathology and Horticulture, at State Agricultural College and Experiment Station, declared to be State officers under this Act for suppression of dangerous insects and plant diseases. Department under control of Board of Trustees of Agricultural College and Experiment Station, which shall fix salaries and control expenses, and are responsible for enforcement of Act.

State Entomologist and Pathologist to seek out and suppress insect pests and plant diseases, and conduct experiments to accomplish same. Inpection of each county annually, and each nursery semi-annually.

Usual provisions grant powers of entry for inspection, condemn infested stock, provide for recovery of costs of treatment from delinquent growers by State's attorney, define use of certificate, prescribe fines (ten to one hundred dollars and costs), require fumigation, prohibit transportation and sale of non-certified stock under penalty. Reports required prior to February 1st, annually, from the three officers above mentioned.

Eight thousand dollars appropriated for proper performance of duties, and for dissemination of information.

Maryland also has yellows law similar to that of Michigan.

MASSACHUSETTS.

Same as New Hampshire Law, except inspectors and deputies receive five dollars per day and expenses up to one thousand dollars per year.

MICHIGAN.

Nursery Law.

State Board of Agriculture to appoint State Inspector of nurseries and orchards, duties of same being to inspect all Michigan nurseries for San Jose scale, or other injurious or destructive insects or contagious diseases. If none found, shall give owner certificate to that effect, no shipments to be made without such certificate. If found infested, shall notify owner in writing to disinfect within five days.

Fine for not destroying infested trees, $1.00 per tree, to be collected by prosecuting attorney of county where nursery is located.

If not disinfected within time specified, State Inspector shall disinfect same. He may employ the necessary assistants, and enter premises for inspection. The owner is liable for costs of such proceedings, and $3.00 per day for inspector's services in inspecting or disinfecting, to be paid before delivery of certificate.

Shipments into the State must bear certificate of inspection, and name of consignor and consignee, with contents. Transportation agent must notify State Board of shipments of non-certified stock within twenty-four hours, or fined from twenty-five to one hundred dollars, or imprisonment, such fine to be paid to State Board.

Nurserymen must apply for inspection, and procure license for selling. Fee, $5.00. License good for one year, and not transferable, and must give bond to State Board for $1,000 to comply with these povisions, and that on demand he will file with State Boad list of persons to whom he has sold nursery stock, list to be held in strict confidence by Board. Penalty for violation, twenty-five to one hundred dollars, or imprisonment. Persons engaged in fruit growing who wish to sell or exchange surplus trees or plants of their own growing are excluded fom these provisions.

Persons from outside of the State selling trees within the State must have a similar license and certificate of inspection of State or Government inspector, or some person designated by the said State Board. Inspector has power to enter any premises where infectious or contagious diseases are supposed to exist, and has power to exterminate them, the same as in nurseries; expenses to be assessed as a special tax on the premises concerned.

State Inspector may appoint such deputies as are required, subject to the approval of the State Board. Expenses incurred, not otherwise provided for, to be paid out of the general fund of State.

Plant Disease Law.

Unlawful to keep trees infected with yellows, black-knot, peach rosette, little peach or pear blight, or sell or ship fruit thereof, except fruit of plum, cherry and pear. Tree and fruit so infected declared public nuisance. No damages shall be awarded by any court for entering premises and destroying such trees and fruit in accordance with this Act.

When danger from such diseases exists, township board or city council shall immediately appoint three free-holders as yellows commissioners to hold office during the pleasure of appointers. Commissioners file acceptance within ten days with township clerk, who shall be their recorder.

Any commissioner shall, with or without complaint, examine for diseases, and mark diseased trees, and leave notice of same with owner or person in charge, and order same uprooted and destroyed by fire within five days; but diseased fruit to be destroyed immediately by owner or commissioner.

Interested persons may make complaint against order of commissioner or commissioners, and request all of them to examine trees condemned. If majority agree in condemnation, they shall order trees destroyed forthwith by owner. If any trees or parts of trees found not diseased, shall revoke order relating to the same. This does not apply to the diseased fruit or parts of trees with yellows. If owners neglect to destroy, the commissioners shall do so, and charge same to township or county. Commissioners given power to enter premises to perform these duties.

Owners neglecting to destroy trees condemned, subject to fine not over one hundred dollars, or imprisonment. Justice of the peace shall have jurisdiction over the same.

Commissioners allowed two dollars per day and expenses, to be certified on October 1st to Supervisor of City Council, and levied as tax on owner of trees condemned.

Pest Law.

Duty of everyone to properly spray plants affected with injurious insects and diseases but not when in bloom; those with San Jose scale to be effectively sprayed or destroyed. Otherwise this law is the same as the foregoing except the fine only $50.00.

MINNESOTA.

Entomologist at State Experiment Station charged with execution of law. May appoint assistants, fix and pay their compensations. Inspections to be between first of May and fifteenth of September, annually. Certificates to be granted on payment of fee at rate of $5.00 per day and expenses for inspector while investigating condition of nursery.

Usual powers of entry are granted, condition and penalties (ten to one hundred dollars fine and costs), for use of certificates prescribed, methods of recovering costs from owners, prescribed, expenses to be met from income of fees and fines.

MISSISSIPPI.

(No Law).

MISSOURI.

Fruit Experiment Station.

Object to experiment with different kinds of fruit, their diseases and insects. Given power to destroy and remove infected trees or orchards, if necessary, to prevent spread of insects of diseases.

Board of three trustees appointed by Governor, who appoint manager and inspector.

Upon petition of five free-holders in the State, they shall secure services of inspector to examine locality for dangerous, infectious diseases of trees.

Inspector shall go to locality indicated, and recommend prevention or methods of eradication, petitioners to report to him the result of treatment prescribed.

If inspector finds trees or orchards with diseases liable to spread to others and destroy them, he shall notify offices of county court to notify owner after ten days to show cause why such trees should not be dug up and burned. If the court finds inspectors report correct, the inspector shall take up and burn such trees. Laborers employed to do same should receive pay not to exceed $1.50 per day for services, to be paid by said

Fruit Experiment Station. Inspector given power to enter premises to destroy such trees.

Protection of Fruit Trees.

Trees sent from other States to be plainly marked with name and address of consignor and consignee, and character of contents and certificate of inspection by proper officers. Non-certified stock is to be reported by the transportation agent, and not to be delivered to consignee without certificate. Fine for violation, from one hundred to five hundred dollars.

MONTANA.

State Board of Horticulture, seven members. Governor, who is one, ex-officio, appoints other six, no one of whom, nor any employee of said Board, shall be in any nursery business. Each of the six commissioners shall represent one of six districts created within the State, and shall be resident in his own district. Shall be especially qualified by study, experience and knowledge of horticulture and dependent industries. Tenure of office, four years; two new members every two years. Each member shall take oath of office. Board may employ a secretary, who shall perform duties and hold office at pleasure of Board.

Board shall meet twice each year, and often, as necessary; may call meetings of horticulturists and others, and publish at discretion. Expenses so incurred, limited to $300 per year; actual expenses to be paid, but no salaries.

Office of Board shall be located by majority of Board, and shall be in charge of secretary, who shall receive $1,000 per year salary.

Board may prescribe regulations for inspections, etc., of plants, materials and articles which may be dangerous to orchards. Regulations to be published in two horticultural papers in general circulation in State, and to be posted at Court House and two other places in each county. A second use of packages or wrappings for fruit or nursery stock is prohibited, and the destruction of such crates or other containers is ordered. Any member or officer of Board is authorized to destroy by fire, without breaking any crate, wrappings or other covering, whenever found, and to prosecute all violations of law.

One "inspector of fruit pests" to be elected by Board for each district, properly qualified, serving at pleasure of Board. He shall visit all places concerned in horticulture or nursery work, shall see that regulations of Board are fully complied with, shall have free entry to all premises, and full power to enforce rules of Board. Compensation, $5.00 per day for time employed. Special inspectors and one inspector at large may be appointed by Board to perform prescribed duties, at a compensation not to exceed $5.00 per day actually employed.

All shipments of stock must be preceded by notice of shipment to secretary of Board with destination and consignee given. Shipments shall be inspected and certified, treated or destroyed, according to condition. Fee of $10.00 per carload or pro rata, but not less than $2.00 for each inspection. Fruits to be inspected at rate of two cents per package or $5.00 per car. All such charges to be paid before issuance of certificate by inspector. Quarantine stations to be designated where such imported stock shall be inspected. Failure of any person to comply with orders is guilty of misdemeanor; fine twenty-five to three hundred dollars.

Upon discovery of diseases or insects owner of infested stock shall notify district inspector, who shall direct proper treatment, which shall be given at owner's expense. Failure to follow instructions, fine, twenty-five to three hundred dollars. When owner fails to eradicate pests as directed, inspectors shall do so, and expenses incurred shall be a lien on property.

Delivery of uncertified stock is punishable by fine of twenty-five to three hundred dollars; damages to stock incurred by being held for inspection and certificate not recoverable.

Secretary of Board shall keep all records, collect books, etc., containing horticultural information, collect statistics, correspond with colleges, schools and societies, and prepare reports for publication; he shall also act as assistant to the inspectors.

Board shall biennially report to Legislature its work, abstracts of inspectors' reports, and of Secretary's report. $3,500 for year 1903; $2,500 for 1904 appropriated. Fines and fees collected turned into Treasury of State to credit of Board, to be used so far as possible for expenses of Board.

Delivery of non-certified fruits is a misdemeanor.

Engaging in nursery business without license prohibited.

Licenses obtainable for one year, from State Board of Horticulture, on application; filing of bond ($1,000) for compliance with all State laws, which shall guarantee fumigation of stock, and expenses of inspection or destruction of any infested stock. License revocable at pleasure of Board for violation of provision of this law.

All persons licensed to do business shall mail notice of intention at least five days before shipment of nursery stock or other plants, either within or into the State, giving names of consignor and consignee, invoice of goods, name of transportation company, and its office nearest to destination.

Every package of nursery stock shall bear on label names and addresses of consignor and consignee and invoice of contents.

Receiving nursery stock without giving opportunity for inspection, or that has not been inspected, is illegal.

All nursery stock grown in State shall be inspected, and when needed, fumigated, after which certificate shall be issued for clean stock. Five days' notice from nursery is required when stock is ready for inspection.

Violation of any part of this Act a misdemeanor, fine, from twenty-five to three hundred dollars.

NEBRASKA.

(No Law.)

NEVADA.

Board of County Commissioners to appoint, on petition, a County Horticultural Commissioner, acting for two years as inspector for county. County may be divided into districts, each under local inspector (no compensation). Usual powers are granted inspecting officers and regulations made for abating nuisance of infested stock.

NEW HAMPSHIRE.

State Board of Agriculture shall annually appoint qualified scientist to be State nursery inspector. Said inspector may appoint necessary deputies, not exceeding two.

Inspector or deputies shall inspect once each year all nursery stock, and if no dangerous insects or fungous pests found, shall issue a certificate. If found, the owner shall spray the same as inspector shall prescribe. After subsequent inspection, certificate shall be given if pests have been suppressed.

Selling nursery stock without certificate is subject to a penalty of twenty-five to one hundred dollars. Affidavit of fumigation attached to each package shall exempt it.

Nursery stock shipped from other States shall bear certificate of inspection. Uncertified importations to be returned to consignor at his expense, or inspected by State nursery inspector. Certificate of fumigation, however, shall meet these requirements.

State Inspector shall determine season for inspecting nurseries, and form of certificates given, but no certificate shall continue in force after July 1st following date of inspection. Power is given to enter any private grounds in performance of duties. Cost of inspection not to exceed three hundred dollars annually.

Violations to be prosecuted by Secretary of the State Board of Agriculture.

NEW JERSEY.

Entomologist of Experiment Station is State Entomologist, his compensation to be determined by Executive Committee of State Board of Agriculture, which may also appoint assistants and inspectors, and fix their compensation.

Growers and dealers in plants required to keep their plants free from injurious insects; infested plants are nuisances—their presence after notice to owner is a misdemeanor. Fine, $100 and costs.

Nursery defined to include the growing for sale of fruit, shade or ornamental plants, but excluding "florist stock" grown under glass. Nurserymen, persons, firms or tenants growing nursery stock.

Unlawful to sell or deliver stock without certificate; violation cancels certificate.

Fumigation of stock required at every nursery under direction of State Entomologist. Stock not fumigated, not salable, except when certified as clean by State Entomologist. But evergreens, conifers, herbaceous and florists' plants are exempt.

All nurseries to be inspected annually at convenience of State Entomologist, previous to first of October, inspections to be without cost to grower.

Certificates to be issued for clean stock, for stock subject to fumigation, upon reinspection for clean portions of nursery in which infested trees were destroyed. Any conditions imposed shall be made and accepted in writing.

Shipments without certificate, or under fraudulent certificate, punishable by fine, $100, and at discretion of State Entomologist cancellation of certificate. Shipments into State shall bear certificate of inspection, stating also whether stock was fumigated or not. Absence of such certificate shall subject stock to inspection by State Entomologist. Certificates on infested stock imported shall be disregarded, and all future stock from same nursery shall be regarded as uncertified, and be so treated.

On complaint, State Entomologist shall inspect any property suspected of maintaining a nuisance (infested plants), notify owner of conditions found, giving directions for treatment; owner may within three days appeal to State Board of Agriculture, which determines final action. Any grower of fruits may request inspection, and State Entomologist shall inspect and shall inform owner how to treat such plants as may be suspected of infestation, to preserve them or to prevent spread of insects.

Failure to obey orders of State Entomologist is a misdemeanor, fine, fifty dollars and costs, together with court order when needed to enforce destruction of condemned trees. All prosecutions are to be made in name of and by State Board of Agriculture, through Commissioner of Appeal. All fines, etc., less necessary expenses, shall be converted into the State Treasury, with detailed report on same.

State Entomologist is empowered to enter any property he deems it necessary to inspect, and any one hindering him becomes a disorderly person, and is punishable as such. Three thousand dollars appropriated.

NEW MEXICO.

(No Law.)

NEW YORK.

No person shall knowingly keep any trees affected with the contagious disease known as yellows, black-knot, or the disease known as little peach, or infested with San Jose scale, or other dangerous pests. Every such plant or tree is a public nuisance, and shall be abated without damages for entering upon premises for inspection, nor for trees or plants destroyed on account of diseases or insects infesting them by order of Commissioner of Agriculture or his agents. Every person shall report to the Commissioner of Agriculture the presence of dangerous diseases of insects on his trees. If found necessary to destroy trees, notice shall be given to that effect within ten days granted for performance, citing law authorizing order. Treatment may be given, instead of destroying trees, when feasible. Failure to comply with directions of inspectors a misdemeanor. Appeals from inspectors within three days may be made to Commissioner, and his decision is final, and carries power to enter any premises to carry out such decision.

Commissioner of Agriculture empowered to take such steps as he may deem necessary for control of insects and diseases, including inspections annually before September 1st of all nurseries, etc. When healthy, certificates shall be granted. No sales allowed without certificate of current year attached to every package. Persons shipping non-certified packages commit misdemeanor, including transportation companies, who shall notify Commissioner of any such packages, with destination, consignor and consignee given. All stock grown within one-half mile of place where San Jose scale has been found within two years shall be fumigated by grower, consignor or consignee before planting or reshipment, except under given exceptional conditions.

All imported stock shall have certificate of inspection; in absence of certificate, transportation company and consignee shall both notify Commissioner of Agriculture, and stock shall be fumigated. Purchases of less than one year's standing in a nursery shall exempt other stock not purchased at same time.

Certificates not required on stock shipped as interstate or foreign commerce, nor on native stock not grown in regular nurseries.

NORTH CAROLINA.

Nurserymen and agents must have license from North Carolina Commission for control of crop pests.

Transportation companies shall not deliver plants or trees without name and address of nurserymen growing same, and certificate of inspection less than six months old. Uncertified stock declared a public nuisance, and may be seized and destroyed by agent or State Commission. Transportation companies receiving such stock uncertified and labelled shall destroy or send them out of the State within forty-eight hours, if from without the State. If from within the State, they shall be destroyed by fire. No one shall open same except persons authorized by Commission, except they are shipping or destroying same.

No one may keep plants or trees harboring insects declared dangerous pests or diseases by this Commission unless treated according to methods prescribed by this Commission.

Upon certification by two reputable citizens of their belief that such pests exist in their county, Commission shall examine and verify same.

Commission for extermination of noxious insects and fungous diseases and weeds to consist of State Commissioner of Agriculture, Director of Experiment Station, President of Horticultural Society. Members to receive no salary, but only necessary expenses.

Commission shall prepare and publish list of dangerous crop pests present within the State, or liable to be introduced; may at any time amend same, and publish methods for exterminating and preventing the spread or introduction of pests, and regulate their transportation, such regulations to have force of laws, if not inconsistent with the State Laws and Constitution of the United States.

Plants and premises infested are declared a public nuisance. When notified by Commission, owners shall take the prescribed measures to eradicate such pests, or if not done or improperly executed within ten days after notice, Commission shall free such premises from pests by best possible method, the cost to be lien against premises. No damages to be awarded to owner for entering premises, or destroying infested plants by Commissioner.

Commission to appoint competent person to inspect suspected places, and to take measures for treating as Commission may direct. Said Agent authorized to enter and inspect any premises between sunrise and sunset. Prevention or interference with said inspctor subject to fine of five to fifty dollars, or imprisoment.

Five hundred dollars appropriated for provisions of this Act.

NORTH DAKOTA.

(No Law.)

OHIO.

It is unlawful for anyone to keep on premises under his control or ownership any trees infested with yellows, black-knot or other infectious disease, San Jose scale, canker worm or Gypsy moth, or other noxious insects, unless such trees are treated under direction of Ohio State Board of Agriculture. Such infested trees shall not be sold or given away by any person.

Ohio State Board of Agriculture shall appoint competent inspector and assistants, who shall, under direction of Board, perform the inspections prescribed. Once a year, or oftener, if needed, nurseries and premises of nurserymen shall be inspected. Where apparently free, granted certificate, dated prior to September 15th, good until following September 15th. Duplicates of all certificates must be filed with Secretary of Board of Agriculture. Infested plants shall be treated as directed by inspectors before certificate may be granted. Subsequent inspections at discretion of inspectors, and Board may revoke certificates when stock is subsequently found to be infested, and may order and enforce necessary treatment before granting renewal of certificate. Applications for certificates must be made each year prior to a date selected by Board; subsequent applications to be acted on at earliest convenience of inspectors, traveling expenses of officers making such examination to be met by owner of stock inspected. Right to enter any premises in prosecution of this work granted inspectors during business hours.

All shipments, except for scientific purposes, shall bear certificate of inspection. Illegal use or mutilation of certificates punishable by fine, as later given.

Nurserymen required to furnish inspectors with conveyance to and from railway station and nursery plantations.

Every package shipped into State shall have certificate of inspection. Non-certified stock shall not be delivered until after State Board of Agriculture, or its inspectors, have been notified, and an inspection of such stock made, and certificate issued. Failure to give notice is a violation of this Act. Inspectors are authorized to inspect suspected stock wherever found. Infested stock in transit shall be held for ten days, subject to orders from shippers, who shall receive immediate notice of seizure. After ten days seized stock may be destroyed. Expenses of inspections, etc., under this Act met by special appropriation, and from fines collected. Florists' stock is exempt. Annual report of work and expenses shall be made to Governor and to State Horticultural Society.

Inspectors shall turn over all moneys received by them under law to State Board of Agriculture. They shall make itemized reports of expenses to Board, which shall certify such expenses, to be paid from State Treasury.

Upon petition of free-holder, or lessee, any premises may be inspected. If found infested, notice to that effect in writing shall be sent to owner or lessee with prescribed treatment, and limit of time allowed for treatment, after which such trees shall become public nuisances, and shall be abated as such, if directions are not complied with. Estimated distance from other trees and nurseries shall be given. Failure or refusal to comply with directions of inspectors, or provisions of law, is a misdemeanor, fine, ten to one hundred dollars for first, fifty to three hundred for subsequent offenses, with costs. County attorney shall prosecute, in probate court, which shall have original and final jurisdiction in cases under this law, and in such cases it shall be open court, fines to be collected by County attorney, and go to State Board of Horticulture.

Failure on part of growers or others to obey within ten days orders from inspectors renders them liable to suit in probate court, such actions taking precedence over all others. Trial to be by jury, sole issue to be whether infestation exists on the stock concerned, as alleged in the required affidavit of the State Board of Agriculture, which affidavit forms basis of suit. Form and manner of suit is prescribed, costs to be paid by losing side. Appropriation to State Board of Agriculture, $15,000 for 1902 and 1903.

OKLAHOMA.

(No Law.)

OREGON.

Board of Horticulture appointed by Governor, Secretary of State and State Treasurer. Board of six members, one at large, who shall be president and executive officer of Board, one each from five districts in which appointees must be residents.

Secretary at $75.00 per month, and Treasurer under $10,000 bond, selected from Board. Board may receive donations and bequests for promotion of its purposes and objects. It may, but without expense to State, appoint lecturer to promote horticultural knowledge.

Quarantine of trees, orchard, etc., may be declared and enforced when necessary, under strict rules.

Quarantine guardians may be appointed to see that all orders and directions of inspection, etc., concerning quarantine of plants or places are fulfilled. Not over $2.00 per day shall be paid them by owner of quarantined premises. Quarantine is an extraordinary precaution. Other provisions essentially the same as Montana law, except that fines are from five to one hundred dollars, or five to thirty days for each offense.

Members of Board are inspecting officers. Expenses of treatment and inspection is a county charge, becoming a lien upon property treated recoverable in like manner as mechanics liens.

Members when acting as inspectors shall be allowed $3.00 per day and expenses. Appropriation of $4,500 from State.

Further provisions under "Hop Law."

All trimmings and cuttings from fruit, nursery or other trees, or hop vines shall be destroyed by fire within thirty days from the cutting thereof. Upon discovery of any pests, it shall be the duty of owner of orchard, nursery, flower garden or hop yard to spray the same for control of pests.

Spray materials shall bear certificate of purity when sold in lots to exceed one pound each. Failure of goods to meet guarantee of certificate punishable by fine of twenty-five to one hundred dollars. Unlawful to sell infested or diseased fruit in Oregon, or to pack, either fresh or dried, such infested fruits. Violation punishable by fine of twenty-five to one hundred dollars. District Attorney to prosecute in justice court all violations.

Rules adopted by Board meet details such as are incorporated in Montana law, and all the following: Exclusion of certain animal pests and their destruction when known. Also foreign infested stock or fruits cannot be landed. Packing materials shall be immersed in boiling water, containing one pound concentrated potash to every ten gallons for two minutes.

Plants infested may be dipped in whale oil soap, three-quarters of a pound to a gallon, at temperature of 100 to 115 degrees for at least two minutes, and shall then remain 14 days in quarantine, and may be treated again. Fumigation may be used for disinfecting purposes. All plants imported into State shall be inspected, and persons possessing such shall have them inspected.

PENNSYLVANIA.

Practically the same as New York law. Inspectors are under Secretary of Agriculture of State.

RHODE ISLAND.

(No Law.)

SOUTH CAROLINA.

Trustees of Clemson College shall biennially select three members to serve as State Board of Entomology, which shall be in charge of execution of the law, and may adopt rules and regulations. Board shall appoint a skilled horticulturist to be Entomologist, to act as inspector, with an assistant, if needed. Salaries fixed by Board. Salaries to be met by appropriation; other expenses from College funds.

Usual provisions for granting and using certificates, entering premises, shipping and selling trees, etc., enforcing law, etc., are incorporated in law.

Under rules adopted, six insects and diseases are declared injurious. Entomologist at Clemson College is State Entomologist. Inspections to be in August and September, annually. Certificates void after July 1st, to be renewed before October 1st. Reports, lists of nurseries, etc., required.

SOUTH DAKOTA.

(No Law.)

TENNESSEE.

(From the Eighth Annual Report of the Commissioner of Agriculture, New York State, for 1901.)

It shall be unlawful to grow, keep, offer for sale, sell, introduce or transport within the State any plants, scions, trees, shrubs or vines without a certificate of the State Entomologist showing the same have been found free from San Jose scale, yellows, root-knot or other pests or diseases. Each package of stock shall be marked with the name of the consignor, name of the consignee, and shall bear the certificate of the State Entomologist. No certificate shall be valid beyond twelve months after date of inspection.

Infested nurseries and floral premises shall be declared a public nuisance, and as such must be abated, or the Attorney-General shall bring proper proceedings to abate it, and the expense shall be paid by the owner.

The State Entomologist may collect a fee of $5.00 for the inspection of a house or floral premises, $5.00 for a nursery of less than 50 acres, and $10.00 for a nursery of over 50 acres, and less than 100 acres, and a fee of $50 for a nursery over 100 acres.

TEXAS.

(No Law.)

UTAH.

(From the Eighth Annual Report of the Commissioner of Agriculture, New York State, for 1901.)

Three members constitute the State Board of Horticulture, and each is assigned a district. This Board shall promulgate rules for preventing the introduction and spread of contagious disease among fruit and ornamental trees. It is made the duty of every owner of an orchard, vineyard or nursery, to disinfect the trees, vines or nursery stock, if infested with any fruit-destroying disease.

Any person spraying trees for hire must get a certificate from the Board.

It is the duty of the Board and the several inspectors to cause an inspection of orchards, nurseries, trees, vegetables, vines, packing-houses and store-rooms, and if found infested with disease liable to spread to notify the owner and give directions for remedy.

All persons or nurserymen shall report to the county inspectors any receipt of trees from points outside the State, and such inspector shall examine all such stock, as well as all stock grown or offered for sale in the State.

VERMONT.

(No Law.)

WASHINGTON.

Practically the same as Oregon. One Commissioner, at $1,000, to be appointed by Governor, who shall have as an essential qualification a certificate of skill in horticulture from Agricultural College. He may be removed for cause; otherwise shall serve four years.

County Horticultural Societies authorized, each of which will nominate a county inspector, who shall be appointed by Board of County Commissioners by certificate, copy of which shall be filed at Takoma, in office of State Commissioner. In absence of local societies, State Commissioner may, after sixty days' notice, appoint county inspectors, all of whom shall make monthly reports to State Commissioner of work and expense.

License required for all nurserymen, and when granted shall be guaranteed by $1,000 bond.

Fines for violation of law from twenty-five to two hundred dollars, or confinement in jail from sixty days to one year.

WEST VIRGINIA.

Director of Experiment Station is responsible for performance of requirements of Act; appoints inspectors to act for him in field. Blackknot, peach yellows and San Jose scale specially mentioned as nuisances, but other insects or diseases are included. Inspection of all nurseries required every year before August 15th. Certificate, good for one year, granted to clean nurseries on payment of $10.00 fee. If more than one day required in inspection, $5.00 per day or fraction shall be charged in addition to regular fee. Duplicate certificates and statement of amount of fee received filed with director. Infested stock shall be treated as may be ordered, or destroyed, and $5.00 per day collected, if inspector oversees treatment.

Florists' stock exempt from inspection, etc. Other provisions similar to other laws in respect to use of certificates, right of entry of premises, collection and accounting of fees, fines (ten to one hundred dollars and costs) for violation or neglect of requirements, filing of reports, etc.

Directors decision in cases of appeal to be final.

Nurserymen must furnish transportation to and from railroad for inspectors. No salary or per diem fixed for inspectors. Traveling expenses to be paid. $1,500 allowed for carrying out law.

WISCONSIN.

Inspector is agent of Director of State Experiment Station.

General regulations in respect to inspections, certification of home-grown or imported shipments, treatment or destruction of infested stock, application for and granting of certificates of inspections. Certificates to be furnished by Director at thirty cents per hundred to nurserymen who shall use them on such stock only as has been certified, and before expiration of regular certificate. Inspectors to receive not over three dollars per day and expenses while engaged. Director to receive no compensation in addition to his regular salary.

WYOMING.

(No Law.)

VIRGINIA.

Board of Control of Virginia Experiment Station declared to be State Board of Crop-Pest Commissioners. State Entomolgist and Pathlogist to be inspector in charge of enforcement of law, under direction of Board of Commissioners. Inspections to be prior to October 1st.

Usual powers are granted and conditions imposed in respect to inspections, use of certificates, filing reports, etc., with penalties for violations.

Local inspectors may be appointed in counties or cities in which San Jose scale is present, salary of such local inspectors to be fixed by County Board of Supervisors or City Council. Six thousand dollars appropriated.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 52. APRIL, 1903.

INSECTS AND DISEASES OF THE TOMATO.

BY T. B. SYMONS, ACTING STATE ENTOMOLOGIST, AND
J. B. S. NORTON, STATE PATHOLOGIST.

From the fact that a large amount of land in Maryland is planted in tomatoes each year, and that in all probability a larger acreage will be planted this year, owing to the good prices paid by the canners, it seems advisable at this time to call the attention of the tomato growers to the more common insects and diseases that are likely to affect this crop.

FLEA BEETLES.

There are two species of flea beetles which are likely to attack the tomato, namely, the cucumber flea beetle, Epitrix cucumeris, and the tobacco flea beetle, Epitrix parvula. Although their common names do not signify that they attack the tomato, nevertheless these beetles feed with almost equal readiness on the several vegetables belonging to the solanaceous family of plants.

The adult beetles are very small, dark brown in color,and are at times rather hard to see, as they are provided with well-developed hind legs, which enable them to jump very quickly when disturbed. It is in this stage that they do their principal injury by eating small holes in the little tender leaves of the tomato plant. They appear on the young plants while they are still in the seed-bed, and are still more troublesome on plants when they are first transplanted into the field. The accompanying figure illustrates the tobacco flea beetle in all its stages.

To avoid injury to tomatoes, or similarly-grown plants, spray the plants while in the seed-beds with Bordeaux mixture, to which has been added Paris green, or other arsenites, at the rate of one-quarter pound to the barrel of Bordeaux. If the plants are given a good treatment in the seed-bed shortly before planting in the field, they should be protected from injury for some days, and until they have been able to establish themselves in the soil. Injury in the field may be prevented by occasionally spraying with Bordeaux-Paris green mixture, or by applying Paris green with air-slacked lime, plaster of flour at the rate of one part of the poison to twenty or thirty parts of the lime, plaster or flour, dusted on the plants from one of the machines known as powder guns, or from a coarse cloth bag or sack.

CUT-WORMS.

The tomato is no less subject to the attacks of cut-worms than are many other crops. Grown in seed-beds, as it is, and set out in newly-plowed fields in the summer, the plants are naturally attacked by the worms, which for some days at least have existed in the soil deprived of food. It is a common experience with agriculturists that cut-worms are always more numerous in the fields left in fallow for a period before planted to certain crops. There is a greater variety of vegetation in such fields, and the moths, which lay the eggs that produce the cut-worms, are more apt to be attracted by it.

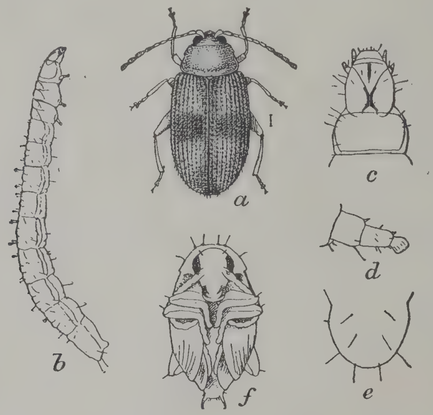

Figure I.—The Tobacco Flea Beetle: a, adult beetle; b, larva, lateral view; f, pupa. a, b, f, fifteen times natural size. (After Chittenden, U. S. Department of Agriculture).

It is a comparatively small matter to rid a field of cut-worms before planting out the tomato, and as a measure of safety this course may be followed to advantage. Often when a field is plowed, and is clear of vegetation and ready for planting, if there are placed here and there over the field small bunches of grass or weeds, which have been sprayed with Paris green and water, it will be found that the cut-worms in the soil, in the absence of other food, will eat this cut, poisoned vegetation, and will be destroyed, so that the tomato plants can be set out without fear of injury. Other means of combating the cut-worms have been discussed by Mr. R. I. Smith, in his circular bulletin entitled "Cut-Worms," which can be had upon application to this Department. Figure IV illustrates one of our common cut-worms, further explanation of which is not necessary.

THE TOMATO HORN WORM.

Every tomato grower is familiar with the large green worms that appear in his tomato patch when the plants are fairly well-grown. These may be the larvae of either of two species of large sphinx moths. Their caterpillars, from the fact that each bears upon one of the posterior segments of its body a rather stout, curved horn, have become popularly known as horn worms. Tomato growers do not distinguish between the two different kinds of horn worms, and for practical purposes it is not in the least necessary, as both species have been found feeding on the tomato plant. Protoparce celeus, which is illustrated with all its stages in Figure II, seems to be more abundant in Maryland.

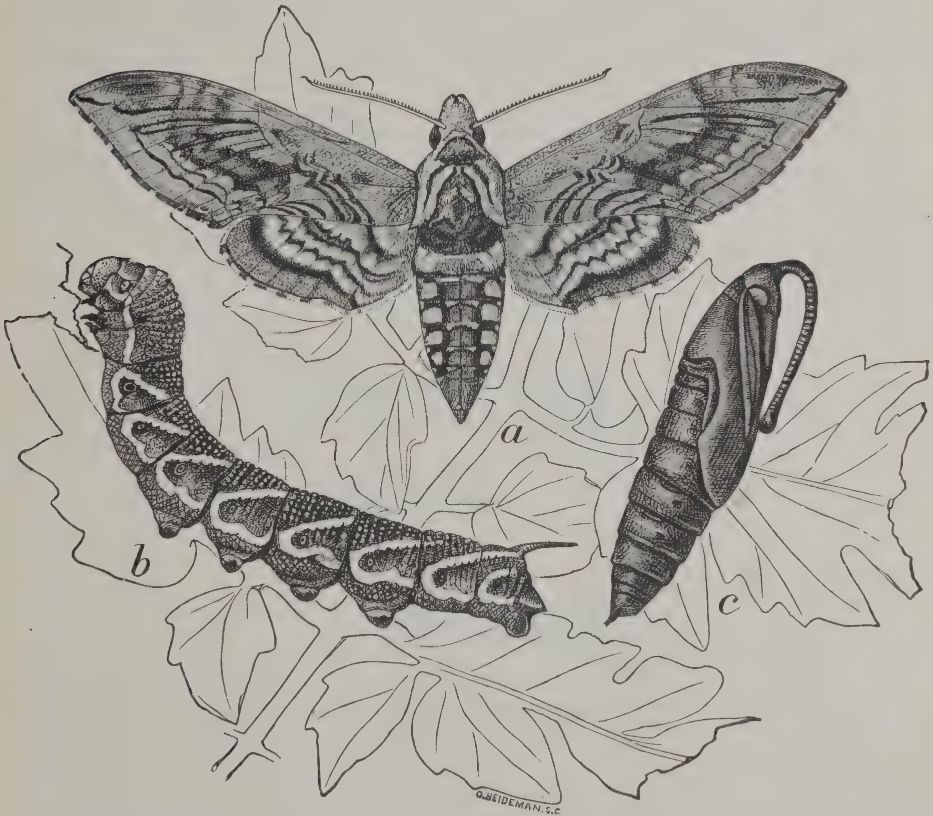

Figure II.—The Tomato Horn Worm; a, adult moth; b, full-grown larva; c, pupa—natural size. (After Howard, U. S. Department of Agriculture).

The moths make their appearance according to the climate, from May 1st until well on into June, and lay their eggs singly on the underside of leaves. The young caterpillars hatch from these eggs in from four to eight days, according to Professor Alwood's observation of Protoparce carolina. There are supposed to be two generations of these insects in Maryland, therefore, two crops of worms.

Both kinds of horn worms are subject to disease and to the attacks of enemies. Caterpillars, which are observed to turn dark in color, are attacked by a bacterial disease, which invariably results in their death. It is also a common occurrence in a tomato field to see one of these worms partly or entirely covered with little white, oval cocoons. Such specimens should not be killed, since the cocoons are those of one of the most important of the parasites of these larvae, which, if allowed to emerge undisturbed, will increase the mortality among the caterpillars.

As to remedial measures against these insects, the old-fashioned method of picking or "worming" will, in ordinary seasons, prove effective in controlling the pests. When the first generation of horn worms appear, an application of Paris green, either dry or in the liquid form, is by far the best remedy when the insects are numerous. I have also seen common crows keep a tomato patch apparently free from these worms.

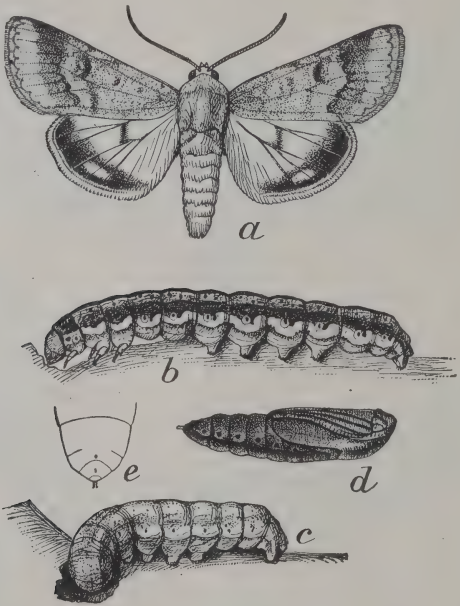

Figure III.—The Tomato Fruit Worm: a, adult moth; b, dark, full-grown larva; c, light-colored full-grown larva; d, pupa—natural size. (After Howard, U. S. Department of Agriculture).

THE TOMATO FRUIT WORM.

This species, which is sometimes called the false bud-worm, is the same caterpillar which when occurring upon cotton is called the cotton-boll worm; upon corn, the corn ear worm, and upon tomato, the above. It is the larva of Heliothis armiger, a cosmopolitan species of various food habits, and which, as its different names denote, has a destructive propensity for boring into fruit or anything like a pod. Its injury to the tomato is caused by boring into the fruit, and one can often see the worm curled up in its hole in a green or half-ripe tomato.

The insect passes the winter in the pupa condition under the surface of the ground. In spring the moth appears and lays its eggs in the buds of some of its early food plants, the larvae doing serious damage by feeding on the young unveiled leaves. It is probably the second or third generation that is troublesome to tomato growers. The insect, with all its stages, is shown in Figure III.

Arsenical sprays will be efficacious to a certain degree against this insect when it attacks the foliage, but when it attacks the fruit there is practically no means of control. It is a case where an ounce of prevention is more effective than a pound of cure.

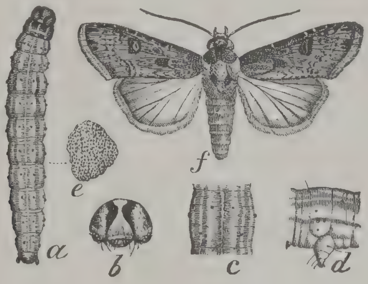

Figure IV.—The Shagreened Cut-Worm: a, larva; f, moth. Natural size. (After Riley).

With this, as with many other insects, there is much to be gained by clean culture in keeping down weeds and other plants on which the insects feed, which may be growing in the vicinity. Late fall plowing is again advantageous by breaking up the little earthen cells in which the pupa are found under the ground, thus exposing them to the action of frost.

There are many other insects which are occasionally injurious to the tomato. Among them may be mentioned the Colorado potato beetle, Doryphora 10-lineata, which sometimes attacks the young plants while in the bed, and also when they are set out in the field. The old-fashioned potato beetle, Epicauta vitata, and the allied species of blister beetles prove very serious at times by eating the foliage. However, an application of arsenical sprays will hold them in check.

DAMPING OFF.

Where tomatoes are grown close together in the seed-bed, decay at the surface of the ground (damping off) is liable to occur with close, damp, air, especially during dark, cloudy weather. Much of this can be stopped by thinning the plants, giving light, air and less water. The surface of the ground should be broken up, and the plants never allowed to become slender, and too close together. The dead plants, and soil near them, should be removed to prevent further infection.

BACTERIAL BLIGHT.

This disease is especially troublesome in the South, and is one of our worst tomato diseases in Maryland. It is indicated by wilting and dark color of stems and leaves. The water-conducting tissue may become filled with the bacterial growth, and cause the plant to wilt or grow very slowly. It is difficult to prevent it, and little can be done for the plants after they are attacked. The same disease occurs on potatoes, egg plant, peppers, and other related plants, possibly on tobacco. The tomato crop should be rotated with other plants than the above, and should not be planted on the same ground again for more than two years. It is preferable to use seed from localities where the blight does not occur. Special care should be taken in the seed-bed, and if diseased plants occur they should be at once removed and destroyed. In the first part of the season diseased plants in the field could be removed, and in bad cases of blight it would be much better to destroy much of the source of future infection by burning the vines after the crop is removed. One of the best methods of controlling this, as well as other diseases, is to spray the plants in the seed-bed two or three times before planting, with Bordeaux-Paris green mixture. This keeps off the flea beetles or other insects which are the means of introducing the blight germs, and also kills any germs which may be on the plants. After the plants are in the field it would be well, also, to spray them with Bordeaux mixture several times before the fruit becomes large.

MILDEW AND OTHER LEAF DISEASES.

Mildew occurs mostly in greenhouses where tomatoes are grown, but may occasionally become bad in the field. It causes brownish, velvety spots on the lower sides of the leaves, and the leaves may soon drop after becoming diseased. Spraying with Bordeaux mixture is a preventive. Several leaf spots attack the tomato plant, and can usually be kept in control by spraying with Bordeaux mixture with the addition of Paris green for keeping down insects which help to disseminate the leaf diseases, and by other means mentioned under blight.

FRUIT ROT.

The rot which starts at the blossom end of the tomato is largely caused by bacteria which are introduced by insects. Removing the rotten fruit as fast as it is found, and destroying the insects which attack the fruit, will prevent much of this. Where the plants can be grown stocky or supported in some way to keep the fruit from the ground, much rot may be thus prevented.

GENERAL TREATMENT.

The best means of controlling tomato diseases is to keep all plants in strong, active, growing condition. Only strong, vigorous, stocky plants should be set out, and as far as possible they should not be checked at any time in their growth. This is one of the principal points in growing perfect tomato plants. If the roots are injured in setting them out, the plants lose vitality, and are much more susceptible to the entrance of blight germs or other diseases, as well as to injury by unfavorable weather.

The plants should be well cultivated and cared for, good land should be used, and rotation (not with potatoes) should be practiced from year to year. Constant cultivation by keeping the moisture in the soil, and keeping weeds down, aids much in keeping the plants in a healthy, vigorous condition. Attention to the plants in the seed-bed is especially necessary. If good plants can be started without contracting disease they will be much more apt to continue in good health during the year. Some varieties are much more susceptible to disease than others. These should, where possible, not be grown. Early varieties are less apt to become diseased, as a rule. Avoid breaking the skin on the plants or fruit during cultivation, or in any other way, as this favors the entrance of disease germs. The plants should be, as before stated, sprayed well in the seed-bed, and when they are set out it is the practice of many successful growers to dip them in Bordeaux mixture before planting. For the preparation of Bordeaux mixture, and its use, see Circular Bulletins 40 and 50.

A few other diseases may attack the tomato, but are, as a rule, not important. Much trouble has been noticed in recent years from failure to set fruit. This is largely due to injury to the pollen by wet weather, or the absence of insects which pollinate the flowers. It is less noticeable on well-drained land or higher ground, where fogs and damp air are not so prevalent.

Some of the resistant varieties that might be mentioned are: For blight, Royal Red, Beauty, Paragon, Dwarf, Champion, Stone, Dwarf Aristocrat. Those more resistent to rot are: Terra Cotta and Lorillard. Others may yet be produced that are more resistant.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 51. MARCH, 1903.

APPLE DISEASES AND THEIR TREATMENT.

BY J. B. S. NORTON, STATE PATHOLOGIST.

Increasing interest in apple culture in Maryland will necessitate more attention to rots, scab, blight and other diseases, which have been already serious in some localities. Most of the apple diseases are easily prevented and treatment for them has been so long and extensively practiced that its success and profitability is thoroughly demonstrated. The following pages gives a short account of the principal diseases of the apple, which may be troublesome in Maryland, with the treatment to be used for them. On page 5 is given a scheme for the general treatment of the apple orchard with reference to fungous diseases. This would need modification for local conditions, and would not be expected to fit conditions in every orchard, but still could be followed as a general guide.

CROWN GALL.

This disease is indicated by rough swellings about the junction of stem and root (See figure I.) or sometimes lower on the root, and usually associated with an unusual number of small roots. This is more troublesome in the nursery than in the orchard, but galled trees should not be planted as they often make a slow growth or soon die.

ROOT ROT.

Slow growth with scanty and yellow foliage usually indicates some root trouble, and is often caused by fungi attacking and killing the roots. Such trees as a rule should be dug up and burned. These diseases are more apt to affect trees of low vitality, from lack of culture, poor soil, drouth or very wet ground. Good care will prevent a great deal of wood rot both above and below ground.

CANKER AND BODY BLIGHT.

The dead areas in the bark of trunk and branches known under these names are mostly caused by the same fungus that causes the black rot of the fruit. Cankers may also be formed by the bitter rot and other fungi. They spread most rapidly in the early part of the season and may occur where the tree is injured by drouth or heat. The diseased portion often extends around the tree or branch, and, if deep enough to reach the wood, may girdle and kill it. The cankers or diseased bark should be scraped out down to live tissue, and painted over with something to protect it until healed over, and also to prevent further growth of the fungus. The following mixtures have been recommended: whale oil soap, 1 pint; slacked lime, 3 pints; water, 4 gallons; wood ashes, to thicken as desired; or formalin, 1 pint; glycerine, 2 pints; water 17 pints. The rotten fruit should be picked and burned, and Bordeaux mixture sprayed on the trunks and branches as preventive measures. The treatment given also applies to pears in which the disease is more destructive.

WOOD DECAY.

Especially where trees are in poor condition, various fungi which live on dead wood may also attack the live wood of fruit trees. These almost always enter through dead limbs or stubs left in pruning. All dead wood should be burned, and exposed wood surfaces painted over. The shelf-like, mushroom outgrowths, which appear on dead branches, may be the fruiting organs of these fungi and should be destroyed.

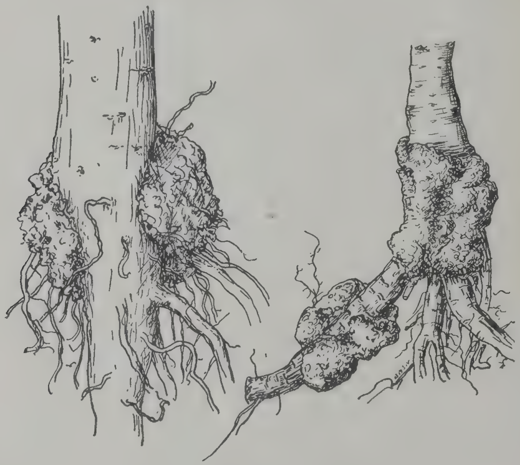

Figure I.—Crown gall on apple at left, on peach at right.

FIRE BLIGHT.

The blight usually begins in the flower, where the germs of the disease are often deposited by bees, and works down between wood and bark in the twigs. When this portion is dead, and the water supply cut off, the leaves die, turn dark and hang on the dead branches, giving a scorched appearance. The best treatment is to cut off and burn the blighted twigs or branches, making the cut three to six inches below the line of blight, and dipping the pruning knife frequently in dilute carbolic acid to prevent accidential infection from it. This pruning can be done a few weeks after blossoming time, when most of the blight has appeared, and again just after the leaves fall in autumn, when the blighted leaves remaining on the tree, will indicate any cases overlooked. This destroys the source of infection for another year, and prevents further extension down the blighted branches. Where only a few twigs are blighted, they should be removed the more carefully since they may furnish the starting point for a serious outbreak another season. The blight often spreads slowly as it is carried by bees and where isolated cases occur, their destruction may prevent a general outbreak.

RUST.

Rust causes yellow spots, on the apple leaves, which are raised and roughened on the under side showing clusters of minute fringed cups. The spores produced in these cups infect the red cedar causing the cedar apples, which in turn form spores that produce the rust in apple and related trees. The presence of cedar trees, near or in an orchard, is almost always associated with outbreaks of the apple leaf rust. When cedar trees thus become a menace to apple orchards, they should be destroyed. Spraying with the Bordeaux mixture is some benefit. The rust sometimes may become established in the twigs and then it is difficult to get rid of. It may also occur on the fruit. Some varieties are affected worse than others.

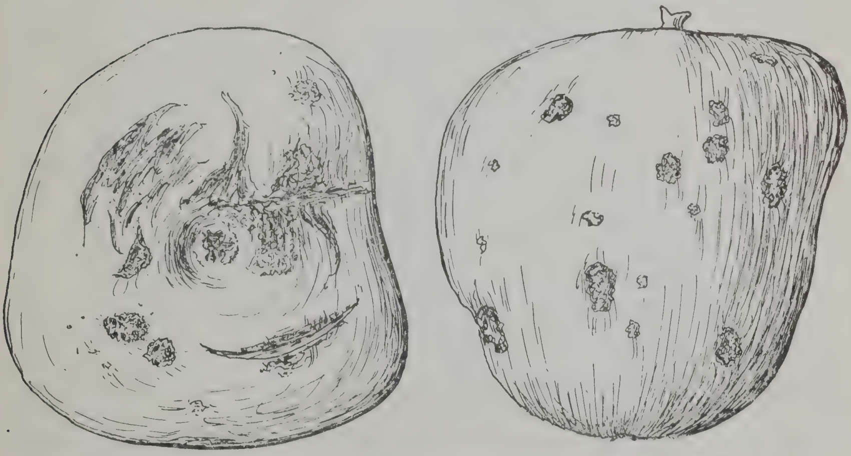

Figure II.—The apple on the left cracked from effect of scab; on the right common effect of scab on apples.

LEAF SPOT.

Apple leaves are often covered with small, roundish, brown spots which may become so abundant as to destroy the foliage, and, if they do not injure the fruit crop that year, so weaken the tree, that it will be much less productive in the future. Most of these leaf diseases can be prevented by two or three sprayings with Bordeaux mixture per year. The scab fungus also may attack the leaves.

SCAB.

Scab causes rough, dark-colored spots on the fruit. The diseased portions of the fruit do not grow well and may crack, rendering the apple worthless, and at least unsightly and unmarketable, and may give entrance to more destructive rot fungi. This is one of the worst apple diseases, but it is very easily prevented by one or more sprayings with Bordeaux mixture applied early in the season, the first and most important just before the blossoms open. (See figure II.)

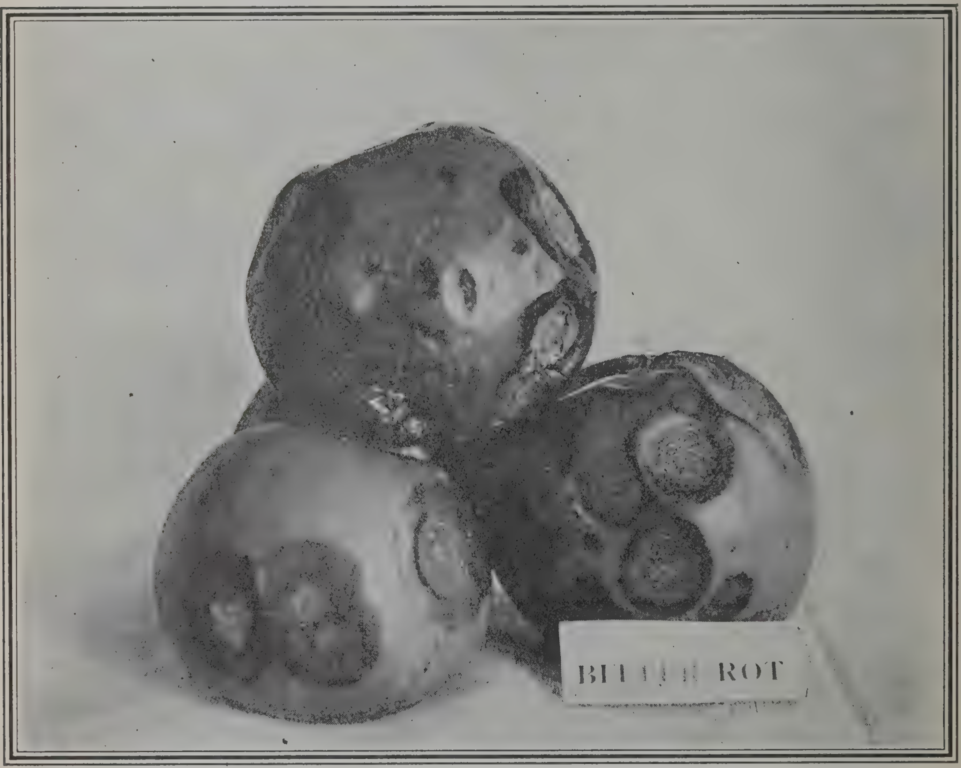

Figure III.—Apples affected with bitter rot. (After Stinson.)

BLACK ROT.

This disease appears as discolored spots on the more mature fruit, which may spread until most of the fruit is covered, and later turns black, the flesh underneath is brown and streaked and dryer. It is caused by the same fungus which causes the cankers before mentioned. The fungus may live over winter in the decayed fruits. These should be all destroyed, the cankers treated, and spraying practiced. Most of the apple rot is caused by the more serious bitter rot.

BITTER ROT.

The bitter rot fungus may form cankers on branches, from which it may spread to the fruit in spring and summer. The rot starts as small, slightly-sunken spots on the fruit, (See figure III.) which may grow rapidly larger and deeper until the whole fruit is destroyed. The spots soon form spores which may infect other fruits, or start new spots on the same. The rot may thus spread rapidly during summer, and even after the fruit is stored, but spreads comparatively slowly from tree to tree. No affected fruits should be left in the orchard, the cankers should be cut out, and no apples with indications of rot should be stored with sound ones. Several sprayings are necessary to keep down the bitter rot, the first to be given in early spring before the buds swell. This disease is more troublesome in the south, but seriously affects a number of orchards in Maryland.

Some less important diseases of apple are fly-speck fungus, which causes the small dots on apples; brown rot of the fruit; brown fungus spots in the flesh of the fruit; watery spots in the flesh; leaf mildew, etc. Serious injury may also result from poor horticultural practices, which do not trouble the good horticulturist, or from weather and soil conditions, which cannot be controlled.

GENERAL TREATMENT FOR DISEASES.

During winter or very early spring all dead branches and remains of fruit should be collected and burned. Blighted twigs should be cut out and all cankers treated. Where large branches are pruned out, the exposed surface left should be covered with coal-tar or some other paint which will exclude moisture. If the orchard is not badly troubled with leaf and fruit diseases, one spraying with Bordeaux mixture may be sufficient, and should be given just after the petals of the flowers fall. (See figure IV.) At this time, Paris green should be added at the rate of one third pound to fifty gallons of Bordeaux mixture for codling moth. For information on the preparation and use of Bordeaux mixture see Circular Bulletins 40 and 50. A week or two after this spraying, the orchard should be examined for blight, which should be cut out and for cankers or sun scald on the trunk and branches. If rot is bad in the orchard, two to five sprayings in addition, during the summer, may be necessary, to keep it in check. One of these should be given before the buds open. This spraying is also necessary, if scab is bad. If close watch is kept, the beginning of diseases can be seen long before they become dangerous and measures of control can be taken. In picking the fruit, the rotten apples should be gathered and burned, or they may be fed to hogs. In the fall, dead branches, especially those on which hanging dead leaves indicate blight, fallen leaves, etc., should be collected and burned. At any time when trees become unproductive from crown gall, root rot or wood rot, they had better be dug up and replaced by more vigorous ones.

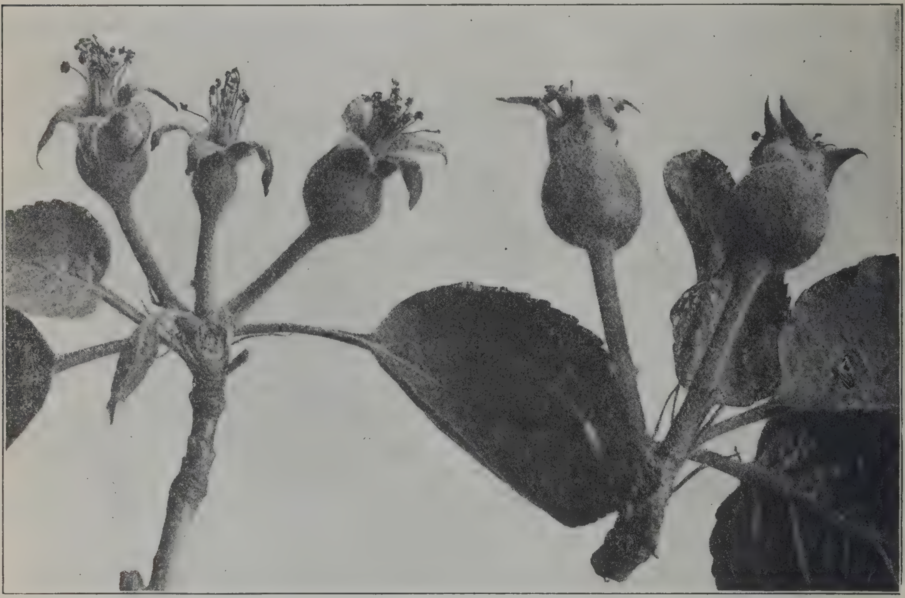

Figure IV.—The young apples at the left are the proper age for spraying; those on the right are too old. (After Quaintance.)

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 50. MARCH, 1903.

BORDEAUX MIXTURE AND ITS USE.

BY FREDERICK H. BLODGETT, ASSISTANT PATHOLOGIST.

BORDEAUX.

Bordeaux mixture is the standard means of controlling fungous diseases, affecting the parts of plants above ground. It is a preparation of the solutions of copper sulphate and calcium carbonate (lime) in water. In appearance it is a somewhat flocculent, light blue liquid, tending to settle when left standing for any length of time; the rapidity of settling being much greater in poorly-made than in carefully-prepared Bordeaux. Its fungicidal power is due to the copper solution present, lime being added to prevent injury to foliage, and to increase the lasting power of the spray on sprayed surfaces.

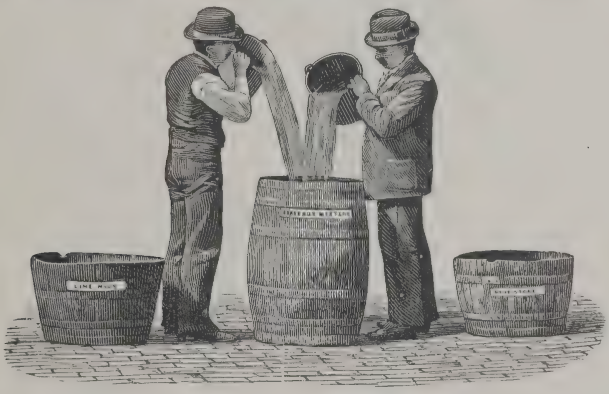

Figure 1.—Preparation of Bordeaux Mixture.

Solutions of copper salts kill living cells of plants, including fungus spores, which they may touch. When used alone, these solutions are likely to injure the more tender parts of the plants. Lime is added to counteract the tendency to "burn" the foliage. "Burning" by Bordeaux is the result of killing the leaf cells in spots by the action of the copper salt on the cells. Burning does not occur seriously, if at all, when proper care is used in preparation of the mixture.

Peach, and probably Japan plum, foliage has the power of absorbing solutions of some substances which may be in contact with the leaves. Copper sulphate is so absorbed and kills the leaf cells quite as surely as if they were fungus spores. Where each particle of copper has a particle of lime with it, the absorption is very much more slow or possibly totally checked, and injury is avoided. This is one reason peach leaves are more easily injured by poorly prepared, or carelessly applied, Bordeaux than are the more hardy apples and pears, and require a weaker preparation. The leaves of peach have practically no protective waxy coating such as is present on apple.

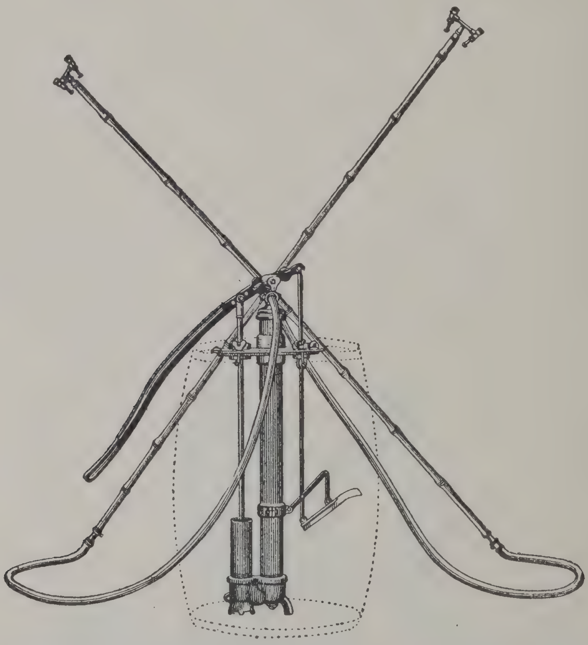

Figure 2.—Large (No. 6) Eclipse pump with two 10 ft. leads, with 10 ft. bamboo extensions, with double nozzles. Price, as shown, except barrel, $24.00.

The germinating fungus spore dissolves the copper salt of the Bordeaux in such quantities as to kill itself before injuring the plant, when the Bordeaux covers the spot when the spore happens to fall.

STOCK SOLUTIONS.

Slake fifty pounds of lime by adding successively small amounts of water until a smooth paste is produced, then dilute to fifty gallons.

Dissolve fifty pounds of copper sulphate in fifty gallons of water by suspending in a sack or closely woven basket just below the surface of the water.

Care should be used to get a high grade of lime, and to slake it thoroughly and smoothly, keeping it covered with water at all times thereafter. It may be convenient to keep the lime in the form of cream-of-lime, rather than in the one pound to one gallon solution. If so, find the number of gallons of water necessary to slake 50 pounds of lime to a cream, and the amount of stone lime in each gallon of the cream, and work as before, keeping the proportions the same (six pounds of lime, four of copper sulphate, fifty gallons of water).

Resin solution for use on waxy plants (asparagus, cabbage, etc.): A—Resin, five pounds; fish oil, one pint; water, four and one-half gallons. B—Potash lye, one can; water, one-half gallon. Boil A until resin is thoroughly dissolved; add B very slowly—a little at a time; then boil until a clear, yellowish solution is formed when added to cold water; use one-half to one gallon to barrel of Bordeaux.

A sufficient amount of stock solution should be prepared, so that any one application may go on with no delays because of lack of materials. One barrel (50 gallons) will give lime solution enough for eight barrels of spray (six gallons of lime each) with a margin of two gallons for spillings, etc. One barrel (fifty gallons) of copper stock will be enough for twelve barrels of spray (four gallons to each); or three barrels of lime stock (150 pounds), and two barrels copper stock (100 pounds) will make twenty-five barrels of spray mixture when properly diluted.

PREPARATION.

For use take six gallons of lime solution well stirred, and dilute to twenty-five gallons, and four gallons of copper solution, dilute to to twenty-five gallons, then pour at the same time from both diluted solutions into the spray barrel (see Figure 1).

For apple, pear, and grape, and for field crops, use as above, also for peach and plum before buds start. For peach and plum in leaf use nine gallons of lime and three gallons of copper; stronger solutions injure foliage.

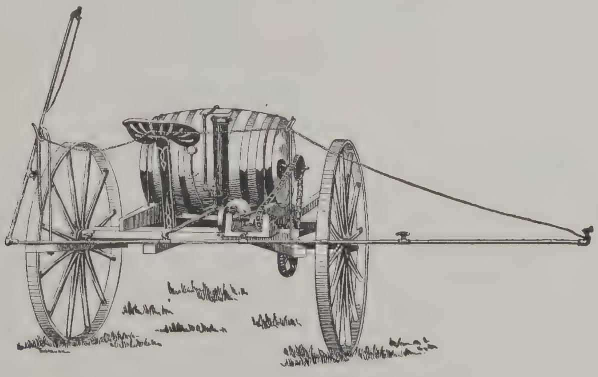

Figure 3.—Peppler's Field Sprayer (six rows, automatic). Outfit includes two leads of hose not shown. Price complete as shown and with extra hose, $75.00; or with hand pump in place of power, $65.00.

Strain all solutions used, including water, unless from wells.

Properly made Bordeaux does not settle rapidly while standing, and has a light blue color of a characteristic shade. Bordeaux which is poorly made, settles rapidly, is greenish or deep blue and, instead of being uniform in color, is more or less blotched or mottled in appearance, and is less efficient as a fungicide, and it does not remain so long on the sprayed surfaces.

TEST.

As lime varies to a considerable degree, it is well to test each lot purchased before applying it as Bordeaux. The test is made by dipping up a little of the freshly made and well-stirred Bordeaux, prepared according to formula in a white saucer, and adding a drop or two of a solution of ferrocyanide of potash.* If there is sufficient lime present no change will be seen. But if there is not enough lime present, or if the lime is weak in strength, a brown or reddish color will appear where the drop strikes the Bordeaux. Add more lime slowly to the Bordeaux until no change of color occurs in fresh samples examined. Then add one quart for safety and the whole amount taken will be safe so long as the same stocks are used. This is a guide for apple and other hardy plants. For peaches take three gallons of sulphate and one and one half times as many gallons of lime as was used with apple. This gives with first grade lime three pounds of sulphate, nine pounds (six plus one half of six) lime to the barrel (fifty gallons). The test cannot be applied directly to the spray mixture for peach, as lime must be in great excess (three times greater than sulphate.)

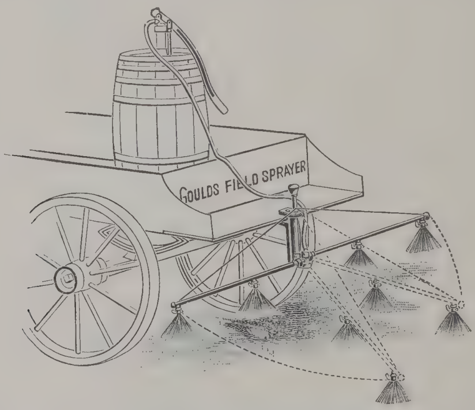

Figure 4.—Gould Mfg. Co.'s Field Spraying attachment for regular spray pumps; dotted lines show position for narrow rows or gateways. Price with coupling for pump, $10.00.

APPLICATION.

The spray mixture being ready to apply, the next step in the work of spraying it to apply it. In the application of sprays, there are two important items to be considered—the pump, and the nozzle. The pump should give a continuous stream under moderate pressure, without excessive labor in pumping. The nozzle should give a fine,

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* Obtain from a druggist; dissolve one ounce in eight ounces water, keep in plainly-marked POISON bottle, with dropping tube through cork, so only one or two drops escape at once. Keep away from inquisitive fingers.

misty spray, not a shower of drops. The separate small globules of sprayed liquids will remain on the leaf or fruit longer than will those of larger size. It is the part that stays that is beneficial, not that which runs off upon the ground. Large drops run together and drop off much more readily than do small ones. The small globules do not tend to concentrate the solution by the gathering of any considerable amount in a spot. The larger drops, however, may contain a quantity sufficient in injure delicate foliage, when the strength has been increased by evaporation of the water, especially if several drops have run together and accumulated at the margin. The smaller bodies of liquid remain distinct, and no one of them contains an injurious amount of the chemical. In addition to these reasons, the surface is more completely covered, as the fine globules can stand thicker than the larger drops, so that there is less space left for any spores to reach the unprotected surfaces of leaf and fruit.

ITEMS OF COST.

In respect to cost the expense will vary with local conditions—amount and wages of hired help, distance to haul between the mixing station and orchard, nature and abundance of water supply, whether flowing or raised by hand. Freight may be neglected, as it is a relatively small amount, one or at most two days wages usually paying the season's freight bills for chemicals. The items just mentioned vary with the location to such an extent that it would be misleading to try to estimate them in a bulletin. But the amounts of spray solution required, and the increased yield per acre may be estimated with fairly definite results, and to these items each grower may add his local expenses to find the total cost to him, if he so desires. The expense for apparatus used varies with the outfit; prices are given for some of the best.

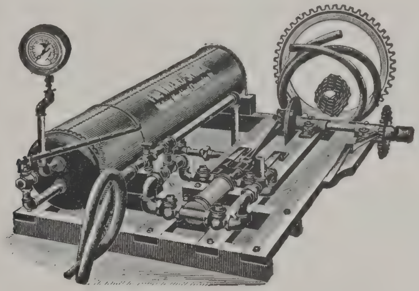

Figure 5.—Air Pressure Sprayer, (Wallace Machinery Co., Champaign, Ill.) Large sprocket is bolted to spokes of hind wheel of wagon, driving by chain the spray pump, which is also air pump. Spray solutions stored under air pressure in tank, pressure maintained by driving from tree to tree. (Price, about $60.00.)

EXPENSES.

Potatoes represent one of the field crops to the sprayed. Experiments by the New York Experiment Station, conducted on Long Island under conditions nearly comparable to those on the Eastern Shore of Maryland, show marked benefit from spraying, even where no blight was prevalent. Using a sprayer to apply Bordeaux and Paris green to four rows at once, it was found that there was a gain in yield of twenty-five bushels per acre when sprayed five times. This was when applied at the rate of two barrels per acre. More recent experiments have shown an increase as favorable, this increase being greater where the number of applications is larger, of course depending on the thoroughness of the application made at the several sprayings. The expenses for the spray chemicals on the above basis of two barrels per acre is:

2 barrels (100 gallons) of Bordeaux with Paris green.	Copper Sulphate	8 lbs. at 5½c........	.44
	Lime	12 lbs. at 1c..........	.12
	Paris green	½ lb. at 18c..........	.09
	Cost of materials, per acre..............		.65

The prices given above are on a wholesale basis, as when purchased in barrels or 100 pound lots; retail prices may increase by one-half or to 99 cents per acre.

Five applications were found profitable in the Long Island experiments, and at the rate mentioned (65 cents per acre) would give a total expense per acre of $3.25 for the season's materials when used at the rate of two barrels per acre at each application. The increased yield of twenty-five bushels at 25 cents would leave a net profit of $2.90 per acre, but potatoes are not often sold for so low a price, hence the profits would be greater than this, on the same basis.

The amount actually used should in any case be proportionate to the size of the plants; less being required for the first application when six or eight inches high, or on dormant fruit trees, than for later ones when the plants are very much larger, or in full leaf. This applies to applications made by hand-guided nozzles. Stationary nozzles on power sprayers use a constant amount, but by shutting off one of each pair at the first spraying, a corresponding decrease in quantity is made. Each row should have two nozzles set a little apart, and at an angle to each other, so as to spray all the leaves; a vertical spray often leaving a considerable amount unprotected, on account of the upper leaves protecting the lower from the spray mixture.

PROFITS.

The profit in the case of cucumbers was over $250.00 per acre, the crop sold in the Brooklyn market. This may be very extreme, owing to excessive abundance of disease in the vicinity killing practically all unsprayed plants in mid-season. But allowing four fifths of the profits to be due to these causes, a profit would remain at $50.00 per acre, which is a fair return; the crop yielded nearly 75,000 cucumbers per acre, more than the unsprayed vines.

For orchard trees two gallons is a fair estimate for each application, to a tree 15 feet high and of equal spread. This would average 25 trees for each barrel of spray, at an expense, as before, of 65 cents, when Paris green is used with the Bordeaux, as for colding moth, canker worm, caterpillars, etc., or of fifty-six cents if Bordeaux only is used (4-6-50 formula). This is at the rate of about 5 cents per tree for each spraying, or 25 cents if five applications per season are made.

Even in an "apple year," one could realize more than that extra, by spraying, on account of superior quality and color. A reputation for growing prime fruit may be built up and maintained by careful spraying.

SUBSTITUTES FOR BORDEAUX.

Most of the experiments which have been performed with full records and care of details, have been with freshly made Bordeaux. There are a number of patented or ready made preparations on the market that claim more or less advantage over the regular mixture. No one of these is known to be any better than Bordeaux, but a number have been tested and found to be distinctly poorer.

It hardly needs to be said that if the patented or prepared Bordeaux is as cheap or cheaper than the regular form it would not be manufactured.

The labor of mixing these dry or paste preparations is often much greater than is the case with the regular Bordeaux.

By the use of stock solutions of the spray materials, little delay is experienced in getting ready for any spray work.

SUGGESTIONS.

When you spray field crops, leave one row or several unsprayed, and keep a record of their yield distinct from the rest (sprayed) of the field, and compare the yield of same number of rows sprayed and unsprayed. This will enable you and your neighbors to see just what good spraying does. Do the same in your orchard, and then you will be able to answer for yourself from your own experience, the question: Does spraying pay?

Others have found profit in spraying, by doing their work carefully, thoroughly and frequently enough to be effective. Why can not you also? And this profit was received even in the absence of serious blights or diseases which may have destroyed the crops if unsprayed; the quality being improved by spraying to such an extent as to more than balance the extra expense. But spraying will not replace cultivation, or other care of crops; it is an aid to good crops in addition to these customary methods. Spraying is, in effect, a means of insurance taken by the growers to enable them to bring to perfect maturity the crop which the plants, under cultivation and other care, are able to produce.

TIMES OF SPRAYING.

First Application.—Cover the trees with a carefully applied fine spray of clear sulphate solution, or full strength Bordeaux before the buds start. This kills many of the hold-over spores and enables the tree to start fair. It is especially valuable against leaf curl and rot of peach, scab and rot of apple, and rot and mildew of grape.

Second Application.—Immediately after the flowers fall, adding one fourth pound of Paris green to each barrel to control insects. For potatoes and cucumbers this should be the regular spray, for melons and tomatoes the poison may be omitted, except when needed especially.

Third Application.—When the fruit is the size of cherries, use poison also, if the insects are troublesome. Keep the spray fine, and the nozzle moving.

Fourth Application.—When the fruit is nearly grown, spray again. This will check the ripe rots, and by using the soda Bordeaux[*] it will not show seriously.

With asparagus, cabbage, etc., add one-half gallon resin solution to the barrel of Bordeaux to help spray to stick.

SPRAYING APPARATUS.

The Pumps.—Whether hand or power pumps are used, a brass plunger, and valves, and brass lined or all brass cylinder, are essential. The valve should be easily reached for examination and cleaning. All parts in contact with spray solutions should, so far as possible, be brass or copper; as iron and steel tend to cause the copper to separate from the Bordeaux solution, especially if not properly made. *Never use iron or steel vessels in preparing the sulphate solution.* Granite or enameled ware dipping vessels are suitable for handling, but use wooden vessels for dissolving the copper sulphate. For hand work, the Morrill and Morley (Benton Harbor, Mich.) "Eclipse," ($13.00) is probably the best, being the result of years of practical work in improvement in Mr. Morrill's orchards in the Michigan peach belt. (Figure 2).[†]

For power spraying, as for potatoes, some of the two wheeled horse power machines are available. Thomas Peppler's (Hightstown, N. J.) "Perfection," ($75.00) is as convenient as any (Figure 3), but has only one zozzle to each row (6 rows). Two lines of hose with nozzles are included as part of the outfit. The Riverhead Agl. Works, (Riverhead, L. I., N. Y.) "Hudson" sprayer has two nozzles, each row, (4 rows) but lacks the wide reach of the first make. By slightly modifying the Peppler, a practically ideal machine would probably result for all work on field plants, so planted that a cart may be driven between rows or belts of rows.

In planting melons, etc., so plant them that a team can be driven through without injury to vines every 20 feet. This will allow the spraying of the plants for ten feet on each side of the road, by the regular barrel orchard outfit, men guiding the nozzles over the plants. By extending the pipes horizontally, 10 feet on each side of cart, it could be distributed by the team, as for potatoes. The pipe would need to be supported by wires and be jointed, to allow passing through gates, etc. Enough nozzles should be used to thoroughly cover the vines. Such an apparatus of smaller size is shown in figure 4, and may be used on any farm wagon, and in connection with any barrel pump, for either Bordeaux, Bordeaux-Paris green or kerosene emulsion.

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[*] Soda (Lewis Lye) 1 lb., lime 5 oz., sulphate 3 lbs., water 50 gals. Dissolve lye in hot water, dilute to 10 gals., add to diluted 10 gals. lime solution. Dilute sulphate to 20 gals., mix the two solutions as for regular Bordeaux, fill up to 50 gals.

[†] The following pumps are also good: Gould Mfg. Co.'s (Seneca Falls, N. Y.) "Pomona," ($15.00), or "Savelot," ($12.50), or the Deming Co.'s(Salem,O.)"Century,"($13.50.) The prices are for pumps alone.

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THE MARYLAND
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STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 49. MARCH, 1903.

CUTWORMS AND METHODS FOR CONTROLLING THEM.

R. I. Smith, Assistant Entomologist.

Cutworms may readily be classed among our more injurious species of insects. Probably every farmer and vegetable grower has had occasion to know that a great amount of damage is done every year by this common pest, and that it is safe to say that only a small number of people take any radical steps to prevent this injury, whereas a few simple precautions might save much time and money. Cutworms working silently in the night often do a vast amount of damage before they are discovered.

In order to successfully combat an insect, it is necessary to know in general, at least, the life history and characteristics of the insect, which usually furnishes a clue to the vulnerable points in its life when it can be most easily suppressed. It is the purpose of this circular to point out certain habits and characteristics of Cutworms, and to give the best known methods by means of which they may be controlled.

Life History.

The moths of Cutworms appear during the months of July, August and September. Eggs are deposited soon after their first appearance, on leaves, stones and rubbish, and sometimes on trees. A grassy sod may be selected as a depositing ground, or any place where there is an abundance of vegetation. The eggs are seldom laid on or in the ground. The little Cutworms hatch in a short time and begin at once to feed on any succulent vegetation at hand. They are now so small and the food usually so abundant that no notice is taken of their presence. By the time cold weather sets in the Cutworms are in different stages of maturity, from one-half to nearly full grown. They now bury themselves in the ground or crawl under dead vegetation or stones, making an oval cell in which they pass the winter. So far no material damage has occurred.

In the spring, however, the land is plowed, and planted with seeds or young plants. The Cutworms now emerging from winter quarters with voracious appetites after their long fast, finding nothing else on the land, immediately attack the young tender seedlings with often very disastrous results. After feeding for a few weeks, the Cutworms reach maturity. They then go into the ground, or under rubbish, and form smooth oval cells in which they change to the chrysalis or pupa stage, (shown in figure I.) from which moths emerge in about one month, ready to deposit eggs for next year's brood. In some instances there are two broods each year, and the moths may appear as late as November or December. In rare cases, Cutworms pass the winter in the pupa stage, or even as adults.

Description and Habits.

Several species of Cutworms occasion more or less damage to crops each year. The adults of all our Cutworms are moths which belong to the family Noctuidæ, meaning, owl moths or night flyers, and for this reason, they are seldom seen except in the evening when some of them may be attracted to lights. During the day they rest at the base of plants, or on stones or rubbish in obscure places. When disturbed they fly with a rapid darting movement, but soon settle down again. The moths range in size from one and one half to two and one half inches in wing expanse; the color of the front wings may be dark brown or grey with irregular markings; the hind wings are always lighter than the forewings. (See figures I. and II.) Cutworms have naked bodies, nearly always tapering a little toward the caudal end; head and first thoracic segment, redish-brown and horney. Cutworms are supplied with eight pairs of legs, the three pairs in front are jointed and horney, the five pairs behind (prolegs) short and stout. In color they may vary from dirty green or gray to dirty brown. They are nearly always marked with longitudinal dark stripes, and occasionally with oblique blotches and black dots. When full grown, Cutworms range from one to one and one half, and rarely two inches in length. When disturbed, many species assume the position shown in figure II. These little rascals have the unfortunate habit of eating partly through the base of young plants, such as cabbages, tomatoes, etc., and of going from one plant to the next, so that one Cutworm

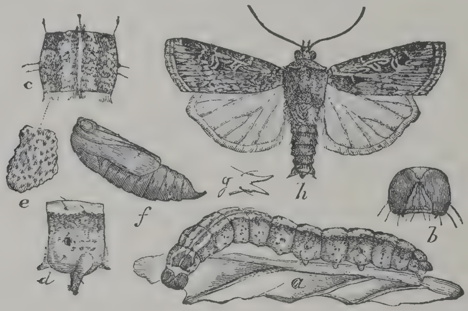

Figure I.—The Granulated Cutworm; a, larva feeding; f, pupa; h, moth—all natural size, (after Riley).

may destroy several plants in one night. During the day they may be found buried in the soil at the base of the plants, or only a few inches away, about one half inch under the surface.

Preventive Measures and Remedies.

Clean Culture.—As stated under the head of "life history," the moths may deposit on a variety of plants. If a crop is removed in midsummer or early fall, and the land allowed to grow a crop of weeds and grass, it furnishes an ideal place for the moths to deposit eggs, and it also furnishes plenty of food on which the young Cutworms may feed. Furthermore, land covered with weeds and rubbish furnishes good shelter under which the partly grown Cutworms may pass the winter. In order to prevent land from becoming infested with Cutworms, it should be kept as free from weeds, rubbish and the like as possible. Rubbish and weeds that are apt to occur along fences, and in fence corners should be cleaned up and burned, as such places afford shelter in which many insects hibernate. Much vexatious trouble may be prevented by keeping all parts of a farm free from heaps of rubbish, decaying vegetation and brush that may harbor insects in their early stages.

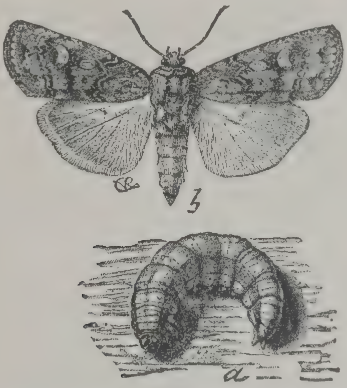

Figure II.—The Dark-sided Cutworm; a, larva; b, moth—both slightly enlarged, (after Riley).

Deep Fall Plowing:—This method against Cutworms, and at the same time against all grubs in the soil, has been practiced with more or less success for a long time. A field that is known to be infested with Cutworms should be deeply plowed early in the fall, and left fallow for the remainder of the season. By this method many moths will be prevented from depositing eggs; and all young Cutworms that have hatched from eggs previously deposited will be buried, and thus perish, or else they will starve for lack of food.

Late Fall or Early Winter Plowing:—In case early fall plowing is not practicable, very late fall or early winter plowing will do nearly as well. At this time the partly-grown Cutworms have gone into winter quarters, and when their cells are broken, they are exposed to the action of freezing and thawing, and perish in large numbers, as they cannot now adapt themselves to circumstances.

Use of Salty Fertilizers:—Under this head may be mentioned kainit which is the potash salt most commonly used against insects. All grubs and worms are susceptible to the action of salts, even when applied as a fertilizer, but it must be used at the proper time to obtain the best results. This time is in the fall, when the ground has just been plowed, and is bare of all vegetation, or in the spring, just before or after the seed is sown. Applied at such times, it is just as beneficial as a fertilizer, and will kill many more insects than if applied when a crop is growing on the land.

One point to be borne in mind is this: If a thousand pounds of kainit is to be used, it should be applied all at once, for if used a little at a time it will prove ineffectual against Cutworms. The same applies to the use of all salty fertilizers.

Trapping:—Vertical holes with smooth hard sides, made with a dibble or walking stick will often serve as a trap for Cutworms. One or more holes should be made within a few inches of each plant. In their nocturnal wanderings the Cutworms fall into these holes, and are not able to crawl up the smooth sides. They may be killed by thrusting the stick into the hole a second time, but this is hardly necessary.

Poisoned Bait:—Spray a sufficient area of succulent clover or some other green vegetation with Paris green, one pound to fifty gallons of water. This should be cut immediately, and distributed in small heaps, or scattered broadcast over a field. The best way to make use of this poison bait is as follows: A field that is thought to be infested with Cutworms should be carefully prepared in the winter for the crop, taking care to leave no grass or weeds upon which the Cutworms can feed. Then a few days before the crop is planted, or just after the seed is sown, place the poisoned bait on the field in rows, or throw it out broadcast. By placing in little heaps or pellets, the bait will keep fresh for a longer time. Finding no other green food, the Cutworms will devour the poisoned herbage, and thus nearly every Cutworm will be destroyed before the crop is above ground.

Another poisoned bait that is eagerly eaten by Cutworms is made by mixing fifty pounds of bran with one pound of Paris green. These should first be mixed dry, and then moistened with enough water to make the mixture stick together. A quart of molasses may be added to sweeten it. Dr. J. B. Smith says that this bait will be eaten by Cutworms in preference to the plants. For crops such as cabbages and tomatoes, a spoonful of poisoned bran placed beside each plant will poison nearly every Cutworm.

Always, if possible, place poisoned bait in a field just before night, as then it will be fresh and more acceptable to the Cutworms. Fowls should be kept from fields while the poisoned bran bait is exposed; otherwise they may be poisoned.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION

STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 48. MARCH, 1903.

THE MORE COMMON SPECIES OF PLANT-LICE THAT AFFECT THE APPLE, WITH SUGGESTIONS FOR THEIR CONTROL.

By T. B. Symons, Assistant Entomologist.

This circular has been prepared to call the attention of apple growers to the more important species of plant-lice that may occur on the apple.

The Apple Leaf Aphis. (Aphis spp.)

When newly born, the apple leaf aphis is almost white, but soon becomes of a pale, dull, greenish, yellow color. The mature agamic females are generally without wings; their bodies are oval in form, about one-eighth of an inch in length, of a pale, yellowish color, often striped with deeper green. The eyes are black, and there is a short, tail-like appendage of a black color. On the back and near the posterior end of the body are a pair of tubes, through which the sweetish transparent fluid is excreted. This substance is known as "honey dew," and it is sometimes produced in such quantities as to form a glistening coating on the leaves and branches below the plant-lice. The winged females and males are very similar in color. The abdomen is short and thick, of an oval form, and bright, green color, with a row of black dots along each side; the wings are transparent with dark-brown veins. Figures I. and II. illustrate a winged male and wingless female respectively, highly magnified, showing the structure and shape of the insect.

Although formerly the apple leaf aphis was considered as a single species, taking different forms, according to recent investigations in Delaware, it has been found that there are three closely allied species affecting the foliage of the apple, differing slightly in their life histories, particularly as to time of appearance and migration, and also varying somewhat in the character of the injury inflicted. The effect of the presence of two of the species results in a more curled condition of the infested leaves than in the case of the other.

Life History.

During the winter and spring there may often be found in the crevices and cracks of the bark or twigs of the apple tree, and also about the base of the buds, a number of minute, oval, shining black eggs. These are the eggs of the species of plant-lice to be mentioned. (See Plate I.)

Although there is a difference between the eggs of these different species, to the ordinary observer they are not distinguishable. These winter eggs are deposited in the fall and hatch at somewhat different times in the spring, according to the species. Prof. E. D. Sanderson gives the life history to be as follows: The eggs of Aphis fitchii hatch in this latitude, from about March 25th to April 25th, according to the season, the majority hatching during the first two weeks in April. The first generation becomes full grown in from seven to nine days. The adults of the first generation are all apterous, viviparous females, and at once commence to give birth to living young at the rate of from three to six per day, for about a week. The second generation becomes grown in about ten days after birth, and the adults of the second generation are almost entirely winged. These winged forms migrate from the apple during the latter part of May, and from then until about October first this species is not seen upon the apple. The winged adults migrate to other food plants, appearing again on the apple in the fall with both winged females and males, and viviparous females, and the eggs are soon deposited in the crevices on the tree. After having oviposited, the aphids die, leaving their eggs to perpetuate the species.

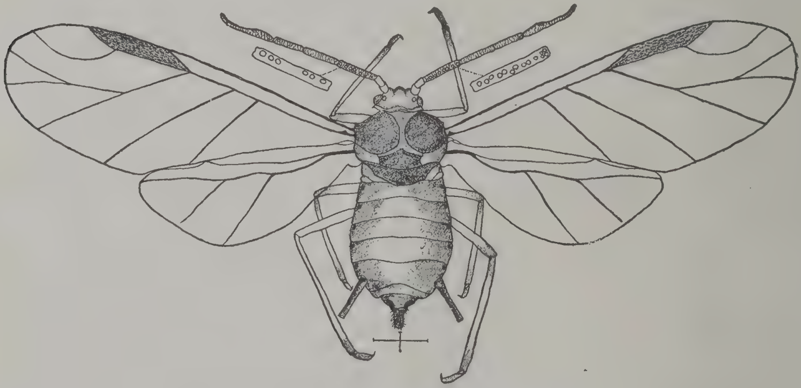
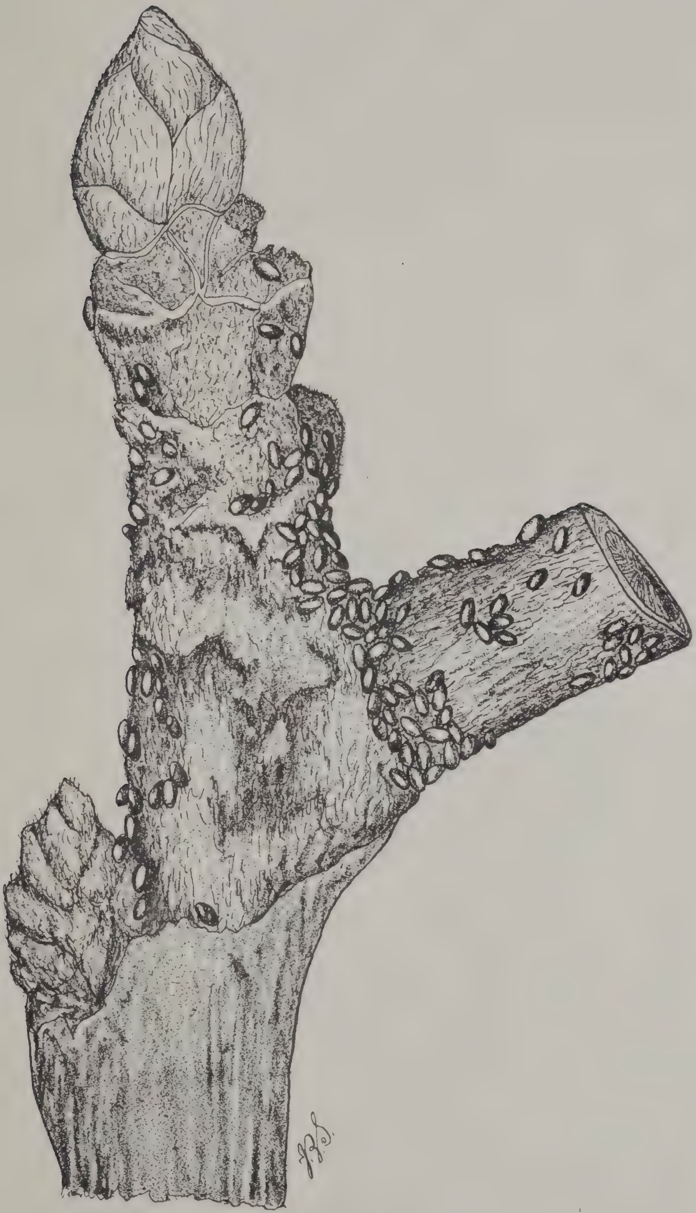


Figure I. Winged apple leaf aphis, much enlarged. (After Smith).

The life histories of the other two allied species are very much the same as above, except in the case of Aphis pomi, which usually does



Eggs of apple plant louse; very much enlarged. (After Smith).

not become very abundant until about the middle of May. Also this species does not migrate to other food plants during the summer, but remains on the apple. This species curls the leaves to a greater extent than A. fitchii, and it is probably the most common of the three.

Eggs of the third species, Aphis sorbi, hatch about the latter part of April or first of May. In 1901, Sanderson found the stem mothers on May second. About the middle of June, this insect migrates to other food plants, returning to the apple in the fall, and completing its yearly cycle by the pairing of the sexes, and the disposition of eggs upon the bark of the trees with those of the other two species.

Suggestions for Control.

Although a contact spray is primarily the only means of combating plant-lice, it is sometimes difficult to reach them, particularly in the case of those more or less protected by curled leaves. From recent experiments in Delaware, it was found, of the numerous mixtures tested, that "Rose Leaf," a tobacco extract, proved the most effective against them. This was used at a strength of one part of the extract to forty or fifty parts of water. When broken into a fine spray, this tobacco extract seems to give off a vapor which is destructive to the lice, destroying in this way those not actually hit by the mixture.

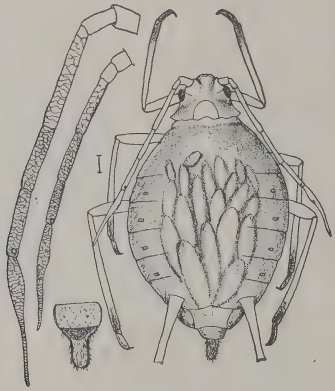


Figure II. Wingless, agamic viviparous apple aphis. (After Smith).

Ordinary kerosene emulsion or a mechanical mixture of coal oil and water used at a strength of fifteen to twenty per cent. of oil, is also to be recommended for a spray against these plant-lice. Crude petroleum, if used in fifteen per cent. emulsion, or the mechanical mixture, would prove to be equally effective.

Whale oil soap has also been recommended, but according to Prof. Earl, it was found to kill only from about two-thirds to three-fourths of the lice, while it rather injured the foliage, when used at a strength of one pound to four gallons of water.

Thoroughness of application is always essential. It must be remembered that these insecticides act by clogging the spiricles of the lice, or by entering into the body through them. Unless the application is thorough, the insect may be weakened but not killed, or, if rendered helpless for a time, they may recover, and a second spraying thus becomes necessary, where one, more thoroughly applied, would have been sufficient. If the spraying be done in the spring as the lice are hatching, it will be comparatively easy to reach them, as they are clustered on the young, expanding leaves.

It is also a good policy to trim trees quite thoroughly in winter, on which there are many eggs, the cuttings, of course, to be promptly destroyed. Thus the number of individuals to start new infestation in the spring will be greatly reduced.

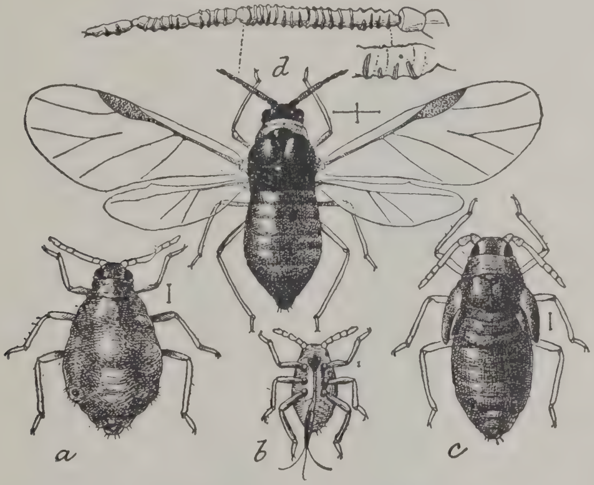


FIGURE III. The wooly aphis of the apple; agamic female; b, larva; c, pupa; d, winged female. (After Marlatt).

The Wooly Aphis of the Apple. (Schizoneura lanigera).

This insect causes injury in two ways. One form attacks the trunk and the branches of the apple tree, while the other lives under the ground upon the roots.

The presence of the aerial form of the wooly aphis on apple trees is readily detected by the bluish-white, cottony or downy substance that is excreted by and covers the greater part of each wingless individual aphis; and since these insects live in colonies, the patches of white matter are very conspicuous, and can scarcely escape the notice of the most casual observer. When present on the limbs, trunk and branches, they cause an abnormal growth of the infested portion, resulting in the formation of a rough and pitted surface, and, at times, cause the death of the parts attacked.

The presence of the aphis on the roots is readily detected by removing the earth from the roots near the trunk of the infested tree. On the roots they produce wart-like swellings and excrescences varying much in shape and size. These deformities seriously diminish the normal supply of nourishment for the trees, and, if very numerous, induce gradual decay of the parts infested. Infested trees generally have a sickly and stunted appearance. The winged and wingless forms together with the character of its injury is illustrated in figures III. and IV.

Life History.

The solitary eggs of the wooly aphis may be found during the winter in the crevices of the bark at or near the base of the tree, where they are usually seen completely enveloped in the dead skin of the mother. In the spring these eggs hatch into wingless agamic females,

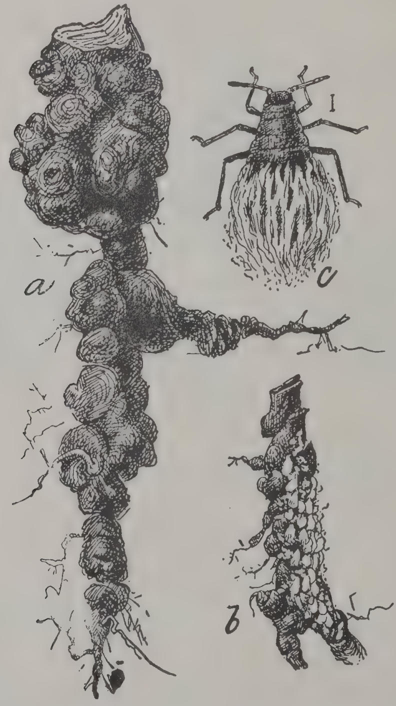


Figure IV. Illustrating the work of the wooly aphis of the apple on the roots; a, an apple root showing knots caused by the work of the insect; b, a colony of aphids on a root; c, a louse. (After Marlatt).

which in turn give birth to living young. This is continued during the summer, each generation being apterous agamic females only. Toward the latter part of summer, winged agamic females are developed. Some of the winged lice may leave the infested trees and fly to other trees, where they start colonies by bringing forth living young. Late in fall, toward the approach of cold weather, some of the agamic females bring forth living, wingless and mouthless true males and females. These pair, and the females each develop a single egg and perish.

Many times these lice will live over a mild winter, as the aphids themselves are usually able to hibernate in large numbers, and hence it is that we can find this species very often in midwinter on roots of trees, but they appear to feed very little, if at all, during the winter.

Suggestions for Control.

The lines of treatment recommended for the leaf aphids will be equally effective against the aerial form of the wooly aphis, but for the root form, other means of control must be practiced. As this pest is very troublesome to nurserymen, great care should be exercised in selecting young stock, to see that it is free from this pest, and that nothing is planted in the way of apple stock until it has been properly fumigated.

The grower should also be extremely careful in procuring young apple trees to see that the pest does not occur on either limbs or roots, as after the aphis becomes established in a soil, it is difficult to effect its eradication.

When occuring on orchard trees in the soil, the trenching around an infested tree and filling the trench with a liberal supply of ground tobacco, refilling the trench immediately after, will have the effect of clearing the roots of this pest. Unground tobacco stems, or coarse tobacco will not answer as it must be finely powdered.

It has also been found that salty mixtures kill plant-lice more or less rapidly; therefore, where root-lice are present, potash in the form of kainit, and nitrogen in the form of nitrate of soda, are advisable. Ten pounds of kainit to a five or six-year-old tree of good size would be sufficient, spreading the material on the surface evenly as far as the roots are likely to extend. As this insect does its worst injury on young apple trees, nurserymen as well as growers should be on the lookout for its first appearance.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 47. FEBRUARY, 1903.

THE CODLING MOTH, AND HOW IT MAY BE CONTROLLED.

By A. L. Quaintance, State Entomologist.

"Wormy" apples are usually the principle item of loss to the apple grower. The larvae of the codling moth are responsible for by far the greater part of this damage. This loss may be largely avoided by the proper use of arsenical poisons in the form of a spray. The yearly loss to the apple growers from this pest throughout the United States is very large. Doctor Forbes estimates that for Illinois this amounts to $2,375,000 each year, and according to Professor Slingerland, the annual loss in New York State is approximately $3,000,000. While many of the apple growers in Maryland regularly spray for this insect, there are also many who do not, and the increasing interest manifested in apple culture and the consequent planting of apple orchards, is reason for believing that injury from this pest will become increasingly noticeable in the future, unless efforts are made to keep it under control. The present circular has been prepared with the idea of furnishing the necessary information to secure the greatest amount of freedom from injury.

Summary of Life History of the Codling Moth.

The insect is shown in various stages in Figure 1. The apple is cut to show the work of the larva within the fruit. The larva is shown at e, the pupa at d, and the cocoon at i. The moth, or adult, is illustrated at g and f; all approximately natural size.

The adult, or moth, appears in the spring as the blossoms are falling from the apple trees, and in the course of a few days begins to deposit its small scale-like eggs on the skin of the young apples or on adjacent leaves and twigs. From these eggs in the course of about a week, the tiny larvae make their escape, the majority finding their way in a short while into the blossom end of the apples. Here the larva feeds around the calyx cavity for several days before boring its way to the inside. About three weeks is spent by a larva feeding within the apple, by which time it has nearly reached its growth. It prepares to leave the apple by making an exit tunnel to the outside, as shown in

Figure 1. The opening to the exterior, however, is kept sealed over until the larva is quite ready to depart. After leaving the apple, in case the apple is still hanging to the tree, it makes its way to the trunk and larger limbs, or to the ground, where, in the crevices of the bark or under trash, a small, silken cocoon is spun, and the pupa stage is entered. In about two weeks after entering the pupa stage, the moth appears, thus completing the life cycle of the insect. Eggs are soon laid for a second brood of worms. Larvae of the second and successive broods do not as a rule enter the fruit at the blossom end, but mostly at the side, particularly where the fruits are in contact. From observations recently made by Sanderson in Delaware, it would seem that in this latitude, part of the caterpillars of the second brood remain as such over winter, hibernating in their cocoons, while others transform to pupae, and later, moths, giving rise to a third brood of larvae, which hibernate over winter. We thus have two full broods, and a good-sized third brood. The second, and more particularly the third brood, may do serious damage by mining beneath the skin of the apples around the calyx cavity, thus disfiguring them and opening a way for more serious injury from rot.

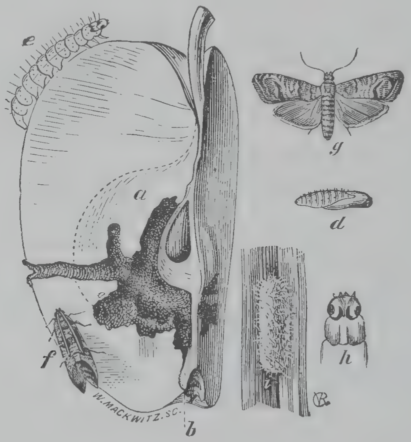

Figure 1—The Codling Moth, after Riley.

The essential points to be kept in mind in the foregoing statement of the life history of the insect are that the larvae of the first brood in the spring enter the young apples at the blossom end, where they feed in the calyx cavity for several days before eating into the interior, and that the larvae of the second and third broods largely enter the fruit at the side. It should also be noted that the larvae in pupating, seek protected places along the trunk and limbs, as well as under trash on the ground, where they may spin their cocoons. These points in the life history of the species furnish a basis for its control.

How the Insect May be Controlled.

First, Spraying.—Extended observation has shown that approximately seventy-five per cent. of the larvae of the first brood of the codling moth enter the fruits at the blossom end, where they feed around in the calyx cavity for some days. It is therefore apparent that if a small quantity of poison can be lodged in the calyx cavity, the little larva will be destroyed in eating its first meal. Many experiments in various parts of the United States show conclusively that if trees are thoroughly sprayed with an arsenite, as Paris green or green arsenoid, just after the blossoms have fallen, or within ten days thereafter, a large percentage of the young apples can be sufficiently poisoned to cause the death of the larvae before they have had time to injure the apple. The spraying, however, must be done thoroughly, and should be done within ten days after the petals have fallen. The reason for this latter requirement will be apparent by reference to Figure 2. The left hand figure shows an apple fruit cluster, from which the bloom has just fallen. It will be noticed that the calyx lobes are still spread, and that the cavity is open and cup-like. These young fruits are in the right condition to spray. The figure on the right illustrates a fruit cluster about twelve days after the petals have fallen. It will be noticed that the calyx lobes have now drawn together, protecting the

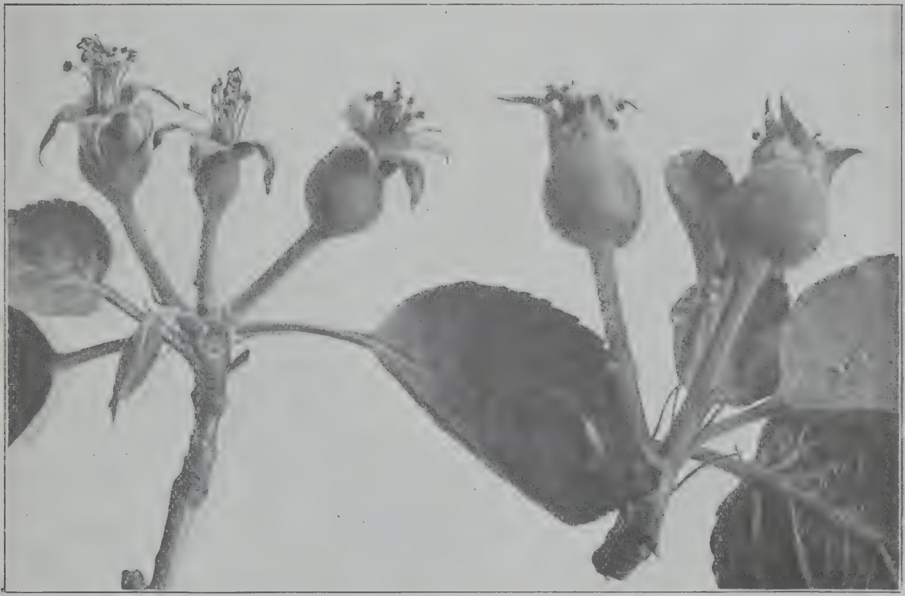

Figure 2.—Two Apple Clusters; on the left, just right to spray; on the right, too late to spray effectively.

calyx cavities to such an extent that but very little poison could be lodged in the blossom end of the fruit by spraying at this time. This illustration will indicate why the work should be done within the time specified. Where possible, it is advisable to make two applications of the poison before the calyx lobes have drawn together. If one treatment be given as soon as the petals fall, followed by another within a week, the probabilities of thorough work will be greatly increased. A second treatment is particularly desirable if a heavy rain occurs soon after the first application has been made, and before the calyx lobes have drawn together. The almost universal use of Bordeaux mixture by apple growers to protect the trees, leaves and fruit from blights and scab, furnishes good opportunity for the use of Paris green or green arsenoid against the codling moth, without extra trouble, as these poisons may be applied just as advantageously in Bordeaux mixture as in water, and should be used in exactly the same proportion, namely, at the rate of one pound of the poison to one hundred and fifty gallons of water or Bordeaux. In spraying, the work should be done from above as much as possible, as the young fruits are standing upright, and in this way the work will be more effective.

Second, the Use of Bands.—Spraying will not be effective in controlling the second and third brood, as already shown, and most relief will come from the use of bands of burlap wrapped around the trunk and larger limbs. Very many of the larvae, in seeking a sheltered place in which to pupate will find their way to these bands. This furnishes a means of readily collecting and destroying them in considerable quantities. The bands should be placed around the trees at least by the first of June, and should be examined at intervals of a week, particularly during late June and early July, destroying all of the pupae found. Very many pupae also occur in loose bark along the trunk and limbs, and it will be advantageous to thoroughly scrape these parts of the tree in order to concentrate pupation in the burlap bandages.

Many apples infested with the colding moth fall to the ground about the time the larva is full grown. These should be kept collected from the ground as they fall, and fed to swine, or otherwise disposed of. If this matter is not attended to promptly after the fruit falls, the larvae will leave the apples, and pupate in the trash on the ground. If proper attention is paid to thoroughly spraying to destroy the first brood, to the use of bandages on the larger limbs and trunks to trap the pupae of the second and third broods, and if the "wormy" apples are kept carefully collected from the ground, injury from this insect will be reduced to the minimum.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION.
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 46. JANUARY, 1903.

THE LIME, SULFUR AND SALT WASH FOR THE SAN JOSE SCALE.

By A. L. Quaintance, State Entomologist.

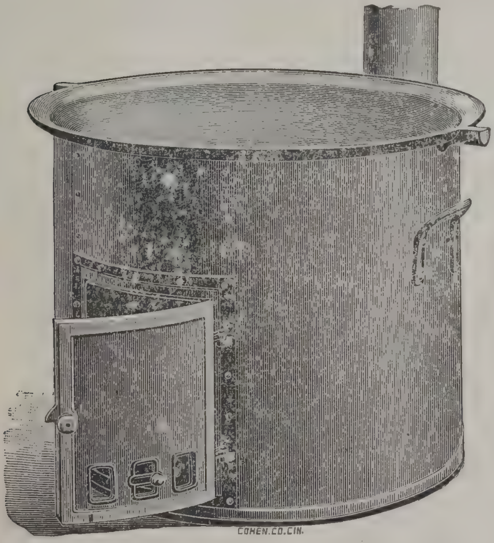
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FIG. 1.

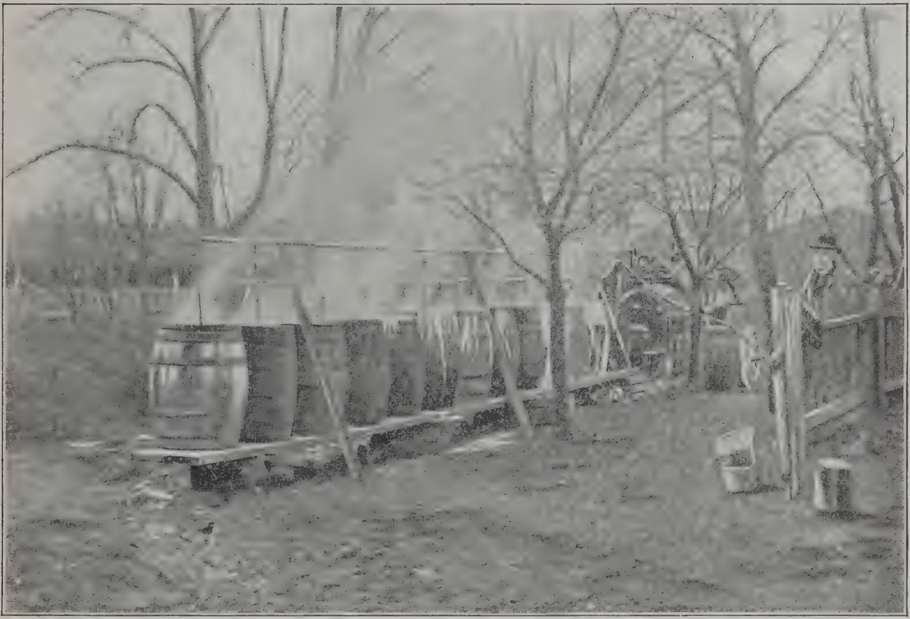
So much interest is being manifested at the present time in the lime, sulfur and salt wash as a treatment for trees and plants infested with the San Jose scale, that it has appeared desirable to present a more extended account concerning its preparation and use, than has been given in Circular Bulletins 44 and 45 of this Department. Interest in this insecticide on the part of orchardists is by no means confined to our own State, and from the present outlook, it would appear that this wash will soon be quite generally adopted in the East as the standard treatment to keep the scale under control.

As is very well known, this treatment has been almost exclusively relied upon by the orchardists of the Pacific Coast for many years past in the control of the scale; and while it has proven quite satisfactory, yet it is to be noted that not infrequently fruit more or less infested with the scale finds its way to our Eastern markets. This results probably more from imperfect spraying, or from failure to spray at all, than from the ineffectiveness of the wash. There can be no doubt, however, of the value of the wash in controlling the scale upon the Pacific Coast, for it will be remembered, that more than thirty years ago (1873) this dreaded pest was found devastating the orchards in San Jose Valley, and soon became widely disseminated throughout that section of country. Yet the cultivation of deciduous fruits has in no wise abated, and despite the ravages of this insect and the consequent necessity for treatment, the Western growers are more than able to hold their own in competition with our fruits on the Eastern markets. The advent of the scale in Eastern orchards naturally suggested the use of this treatment so efficient in its control on the Pacific Coast. Soon after its discovery in the East, therefore, tests of the lime, sulfur and salt wash, along with several others used in the West, were made by the Division of Entomology of the U. S. Department of Agriculture. As a result of this experiment, the conclusion was reached that this wash would not be effective under our climatic conditions in the East, and the experiment in question appeared to warrant this conclusion.

Rather recently the lime, sulfur and salt wash has been taken up by certain orchardists in the East as a possible remedy for the scale, notwithstanding the current opinion that but little relief was to be expected from its use. In a general way the results, however, were quite satisfactory, and information to this effect found its way in the horticultural and agricultural papers of the country. In this State, Mr. S. S. Stouffer of Sharpsburg, was one of the first to make use of the lime, sulfur and salt wash. Concerning the wash, Mr. Stouffer writes under date of January 19, 1903, as follows:

"I first used the sulfur, lime and salt wash in the Spring of 1901. At that time my peach orchard was in bad shape. Quite a number of the trees were so badly coated with scale that the entire tops were killed and had to be pruned down so as to form new heads; a few trees were killed outright. My apple orchard was not so bad. The scale was scattered all over the trees, but none were coated. Although the weather conditions were not favorable, having frequent heavy rains and snow storms following the spraying operations, and before the spray had time to dry, the results were entirely satisfactory, killing at least 95 to 98 per cent of the scale, or every one with which the wash came in contact. I could not see any injury to the trees or buds, no matter how heavy the trees were coated with the spray. In fact I advise a liberal use, completely washing the trees. I do not think of using any other spray and consider it the cheapest, safest and most effective of any wash I have ever used. I sprayed about 1500 trees in 1901, about 4000 in 1902 and expect to treat twice as many this coming spring.

In preparing the sulfur, lime and salt spray, I use a common farm engine and boiler. From the dome of this boiler, a steam pipe should extend out horizontally about 15 ft. with four downward extending ½ inch pipes. I use a common oak barrel of about 50 gal. to each downward pipe, three barrels for boiling the spray, and one barrel for boiling water In a tub or half barrel, place 30 lbs of good stone lime and slack with boiling water; pour into the first barrel, then take 15 lbs. of flour of sulfur and 8 lbs. of common salt and place in same barrel, fill about ⅔ full of water. Now turn on the steam by opening valve above barrel, and in about 5 minutes the spray will be boiling. In 40 minutes charge the second barrel same as first, and in 40 minutes charge the third barrel. After the first barrel has been boiling two hours strain through a fine wire strainer into the spray barrel and enough boiling water is added to make 50 gallons. The barrel should be fastened on a one-horse wagon. One man will be required to work the pump and drive, and two men to take charge of and handle the nozzles (if two leads of hose are used.) Charging the barrels alternately, a barrel of 50 gallons may be sent to the orchard every 40 minutes. One man can attend to the engine and boiling of the spray, and a boy can haul the water as fast as needed The spray is not only effective against the scale, but is a good fungicide, preventing peach leaf curl, rot, etc , leaving the tree vigorous and healthy.



HOW THE WASH IS MADE IN CANADA.—AFTER FISHER.

The cost of material is about 55 to 60 cents per barrel of 50 gallon wash, and the cost of application is about 50 cents per barrel. I begin to spray in the spring as soon as the ground is dry enough to bear a team As our seasons are more or less uncertain, sometimes too much rain or too windy, we must use all of the time to the best advantage ''

Considerable notoriety followed the use of the wash by Mr. Samuel Creely, of Burlington County, New Jersey, who sprayed an infested peach orchard during the winter of 1900–1901. Much credit is due these gentlemen for their independence in adopting a treatment previously shown to be of but little value, and to such instances as these must be attributed, in a measure, the renewed interest in the wash, and the series of careful experiments made in the last year or so by several Eastern Entomologists.

Probably the most extensive experimental work thus far reported comes from Prof. S. A. Forbes, State Entomologist of Illinois, and reported in the Illinois Experiment Station Bulletins 71 and 72, issued in April and May respectively, 1902. It is here clearly shown that, contrary to the heretofore accepted belief, the insecticidal properties of the wash are not leached out by rains to the extent that it is rendered ineffective. In the eighteen different plats treated by Professor Forbes, the average per cent of scale killed by the wash is estimated, by careful count, to have been 99.2. These applications were made early in March. Similar good reports come from Georgia where the wash has been tried on a rather large scale, and reported in Bulletin 4 of the Georgia State Board of Entomology, page 20. In a recent bulletin issued by the New Jersey Experiment Station (No. 162), Dr. J. B. Smith, the New Jersey State Entomologist, presents a conservative statement of the results obtained from the use of this wash in New Jersey. On the whole the effectiveness of the wash is clearly shown, and its increasing use by the orchardists of that State indicates that it has been found to be very satisfactory. At the meeting of the Association of Economic Entomologists in Pittsburg in June last, Mr. A. F. Burgess, Official Inspector of the State of Ohio, reported good results from the tests thus far made with this wash in that State, and at a meeting of the same Association in Washington during the latter part of December, 1902, reports were presented detailing its successful use in Connecticut, Masschusetts and in Ontario. In a recent letter from Mr Geo E. Fisher, Horticultural Inspector, Freeman, Ontario he states that better results have come from the use of the lime, sulfur and salt wash than from any other substance tested. He adds that it will be largely used in that Province the present spring.

Our own tests of the wash in this State were begun in the spring of 1902, and were made in four different parts of the State, namely: at College Park, Prince George's County; at Sharpsburg and Boonsboro, in Washington county; and at Annapolis Junction in Howard county. Careful observations were made on these experiments from time to time, and an exact record of weather conditions wsa kept. These results have been reported on in detail in Bulletin 37, New Series, Division of Entomology, U. S. Department of Agriculture, and need not be considered here. Examinations in June indicated that the wash possessed but comparatively little insecticidal value, and it was estimated at that time, by careful count, that not more than 50 per cent. of the scales had been killed by the treatment. At that time the oily fluid from the bodies of the females could be pressed out in great abundance, by running a knife blade flatwise over the infested parts. Young lice were very abundant, crawling here and there over the branches. Subsequent observations, however, showed that very few of the young scales, hatching from the females which had escaped the treatment, were able to successfully establish themselves on the trees. The comparatively few larvæ, which succeeded in settling, soon afterwards died, and in subsequent examinations it became increasingly evident that the scales were disappearing from the trees. By September 1st live scales were really very hard to find even on trees, that at the beginning of the year, had been very badly infested The old scales had largely pealed off, leaving the bark much brighter and fresher, and the young lice had failed to establish themselves, or died shortly after settling down. It becomes apparent, therefore, that the insecticidal effect of the wash is much more prolonged than has heretofore been recognized, and that the full measure of its efficiency may not be evident until rather late in the season. As those who have used the lime, sulfur and salt solution know, the wash remains evident on the trees for a long time, and the explanation of this continued action is probably to be found in the supposition that the occassional rains leach out from the wash, still adhering to the trees, a sufficient quantity of the insecticidal principles to cause the death of the active larvæ and of those newly settled The young lice are apparently much more susceptible to the sulfur compounds in the wash than the adults, and it appears probable that a very small quantity is sufficient to cause their death. Trees sprayed with the wash thus become more or less protected from infestation with the young lice in the course of their natural spread from one tree to another, and it becomes to some extent a preventive, which can hardly be said of any treatment heretofore recommended for the San Jose scale.

EFFECT ON THE TREE.

The lime, sulphur and salt wash is a strictly dormant tree treatment to be applied in late winter or early spring. If properly made according to the formula and applied at the time indicated, there is no danger of injury to the trees. It has been reported, however, that peach trees have been injured in California by deferring application too late in the spring. Other reports from the same State, however, are to the effect that peach trees may be sprayed, even after the bloom has begun to open, without serious results. But it would appear desirable, particularly in the case of the peach, that the applications should have been finished two or three weeks before the time the buds should begin to swell. In order to secure the continued insecticidal effect of the wash to the fullest possible extent during the following summer, spring applications should be delayed as long as the condition of the trees will permit.

So much injury has followed the use of kerosene and crude petroleum in this and other States, that the success of the lime, sulfur and salt wash in the East is cause for congratulation to all concerned. To meet the conditions in this State, there has been need of a wash which could be applied with an ordinary spray pump. In many cases the work of spraying must be delegated to persons not skilled in the work, and who fail to give the necessary attention to secure satisfactory results from the more complicated pumps, such as the "Kerowater"; and the result has been that either too much or too little oil is discharged, causing injury to the trees and fruit buds, or on the other hand, resulting in failure to satisfactorily destroy the scale. Since the lime, sulfur and salt wash can be used in an ordinary barrel spray pump, such as is employed in the application of Bordeaux mixture, the necessity of the careful attention required by the kerowater pumps, it thus obviated, and there is but little possibility of the spray man doing injury to the trees by inattention to the work. There is apparently no danger in excessive applications. Another important advantage is that treated trees become whitened, due to the use of the lime, and it is thus possible to give a second treatment to touch up the limbs and twigs missed in the first, adding very much to the thoroughness of the work.

TIME OF APPLICATION.

As already stated, the lime, sulfur and salt wash is recommended only as a late winter or early spring treatment, before the trees have made a start. Experiments are in progress at the present time to determine whether or not fall and mid-winter treatments will be as effective, as applications made in early spring. Since the wash appears to be quite effective in destroying young scales hatching three, four or five months after its application, it is probable that its greatest usefulness will result from applications as late in the spring as the conditions of the tree will allow. However, since there are many suitable days for spraying in the fall and winter, it seems desirable that this point should be tested, and possibility of effective work at the times stated will be reported on in due time.

FORMULAS.

Considerable variation is to be noted in the formulas recommended in the different parts of the country. The formula generally used in California, and the one which we have used in our experiment work in Maryland, is as follows:

Quick lime	40 pounds.
Sulfur	20 pounds.
Stock salt	15 pounds.
Water, to make	60 gallons.

According to Dr. J. B. Smith, the formula largely used in New Jersey is:

Quick lime	50 pounds.
Flowers of sulfur	50 pounds.
Stock salt	50 pounds.
Water, to make	150 gallons.

In some experiments reported by Mr. C. L. Marlatt, of the U. S. Department of Agriculture, the California formula was used with the exception that 30 instead of 40 pounds of lime were used. Mr. Marlatt remarks that in the ordinary formula, the lime is very much in excess, and remains as a pure lime sediment, and has to be kept in suspension by agitation. Mr. Stouffer has been using the wash with much success made according to the following formula:

Quick lime	30 pounds.
Sulfur	15 pounds.
Common salt	8 pounds.
Water, to make	50 gallons.

It will be noted, however, that the proportion, approximately, of one pound of sulfur to three gallons of water is constant, and it appears that this proportion should always be observed. In as much as the work of spraying Maryland orchards, is done largely with barrel pumps, holding approximately fifty gallons, it will frequently be more convenient to prepare the wash in fifty gallon quantities. The California formula reduced to furnish one barrel of the wash is as follows:

Quick lime	33⅓ pounds.
Flour of sulfur	16⅔ pounds.
Stock salt	12½ pounds.
Water, to make	50 gallons.

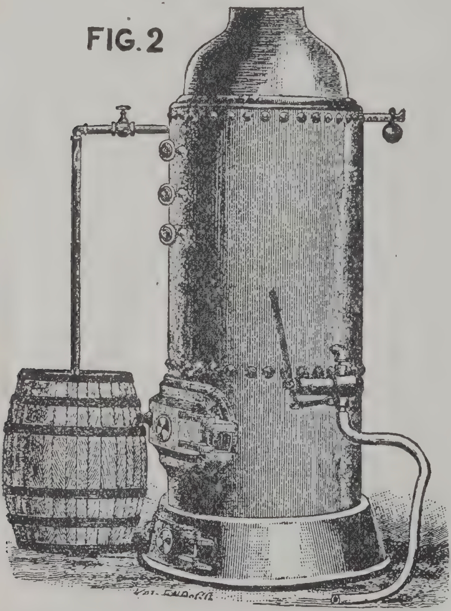
PREPARATION.

There is likewise considerable variation in the mode of preparation, but the California method is as follows:

Place ten pounds of lime and all of the sulfur in a boiler with twenty gallons of water. Boil over a brisk fire for not less than one hour and one-half, or until the sulfur is thoroughly dissolved. When this takes place, the mixture will be of an amber color. Next place in a cask 23⅓ pounds of unslacked lime, pouring over it enough hot water to thoroughly slack, and while it is boiling, add the 12½ pounds of salt. When this is dissolved, add to the lime and sulfur in the boiler, and boil for half an hour longer, when the necessary amount of hot water to make the fifty gallons should be added. I would recommend adherence to the California formula and methods of preparation, until further experimentation shows a change to be desirable.

Some experimentation is reported, notably by Prof. N. B. Pierce, in charge of the Pacific Coast laboratory, F. W. Malley of the Government Entomological Department, Cape Town, South Africa, and by Mr. George E. Fisher, Freeman, Ontario, relative to what particular ingredients in the wash are insecticidal. The tests thus far reported all agree in saying that the lime and sulfur are essential, and the salt, aside from possibly rendering the wash more adhesive, may be omitted. After quite a series of tests of this wash in California, Mr. Pierce recommends the omission of salt, and further advises that all of the lime and sulfur be united and reduced with boiling water before the cooking begins. This proceedure in the preparation of the wash will greatly simplify the work, but the well known influence of salt in whitewash to render it more adhesive, is reason for believing that under our conditions its use would be desirable.

FIG. 2

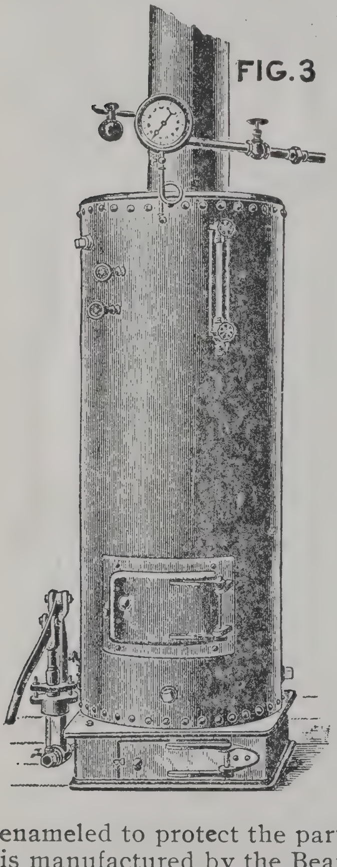


The wash is prepared as previously indicated, by boiling. It is very important that the ingredients should be boiled quite two hours to secure a properly made wash. The cooking may be done in an ordinary iron hog scalder or in steam food cookers (see figure 1) or other suitable receptacles. Where a steam engine of any kind is available, it will be much better to cook the wash with steam. The steam should be conducted in the barrels or vats by means of pipes, which should extend to within a few inches of the bottom of the barrel Where steam engines are not available and an orchard of considerable size is to be treated, it will be, in many cases, economical for the orchardist to purchase a small steam boiler such as shown in figures 2 and 3. Boilers of this size could be readily taken to the field, greatly facilitating the work of preparation of the wash, and would furnish sufficient steam to cook two or three barrels of the wash and keep a barrel of water hot at the same time. By the use of a horizontal feed pipe and vertical pipes, extending down into the barrels to within six inches of the bottom, each supplied with a valve, the cooking could be done with comparatively little annoyance. The barrels should be raised on a platform to facilitate the work of drawing off the wash. On the lower side of each barrel, about an inch from the bottom, a strong wooden faucet should be placed, so that the wash may be readily drawn off in buckets and poured into the spray pump barrel. By having the faucet somewhat above the bottom of the barrel, the excess of lime, which will have settled at the bottom, will be largely avoided. Barrels should be cleaned after the wash has been drawn off. The wash should be strained through a wire strainer, as it is poured into the spray pump barrel to remove any undissolved particles of lime, that might otherwise interfere with the proper action of the pump. After the proper amount of the prepared wash has been taken, sufficient hot water should be added to fill the spray pump barrel, making approximately fifty gallons. The wash should be applied quite warm. Should a quantity of the wash be left on hand at night, it should be well heated the following morning before applying, but this situation should be avoided as much as possible.

MODE OF APPLICATION.

Any pump furnishing a sufficient pressure may be used, and in general a nozzle that is satisfactory for the application of Bordeaux mixture will also be suitable for the lime, sulfur and salt wash. The "Pomona," "Eclipse" or "Century" barrel sprayers will be found suitable for the work. The pumps in which it is proposed to use the wash should be furnished with a strong agitator, otherwise the lime will settle to the bottom and tend to clog the strainer, as well as to give uneven results. In California, the Bean spray pumps (see figure 4) and nozzles are largely used. These are really compressed air sprayers and throw the wash with considerable force against the trees. The cylinders in the pumps are enameled inside, thus protecting them to a considerable extent from the corrosive action of the wash. After a pump has been used, it should be thoroughly cleaned. The hose and pump are very readily injured if the mixture is allowed to stand in them for any length of time. One of the serious drawbacks in the use of this wash is to be found in the fact that it is somewhat disagreeable to apply. The spray man, therefore, should provide himself with a rubber coat, hat and gloves, and many have found a pair of goggles, with clear glasses, very useful. The mode of application does not differ in the case of this wash from that of any other spray material. The main point to be observed is, to take great care that all parts of the tree be treated. It is desirable that the hose be sufficiently long to enable the sprayer to get clear around the tree and finish it before leaving. The treated trees, upon drying, present a whitened appearance, very much as if whitewashed. It is consequently possible to detect any spots that have not been treated, and to go over them again. This renders possible much more thorough work than in the case of the other washes commonly used for the San Jose scale. In all spraying operations, it is difficult to destroy the insect on the more terminal twigs. It is advisable, therefore, that previous to spraying, trees be given a heading back. This will not only add much to the beneficial results from the use of the wash, but, with several classes of fruit trees, the pruning will be of decided benefit. Previous to applying the wash to trees that have been seriously injured, they should be severely cut back. It becomes possible in this way to form a new top to the tree.

FIG. 3



PUMPS AND OTHER ACCESSORIES.

As previously stated, any brass pump may be used, such as employed in the application of Bordeaux mixture. The wash, however, is very corrosive and especial attention should be given to cleaning the pump after using it. A strong agitator is essential, and the "Kerowater" pumps are, therefore, not suitable for his wash, unless the stirring is attended to by hand. The Bean Pneumantic Pump, shown in figure 4, is one largely used in California, and is enameled to protect the parts from corrosive action of the wash. It is manufactured by the Bean Chamberlain Manufacturing Co , Hudson, Mich. Before ordering pumps secure catalogue of the following firms and select the one best suited to your needs: Griffith & Turner Co., Baltimore, who handle pumps for several firms; Gould Manufacturing Co , Seneca Falls, N. Y.; Morrill & Morley, Benton, Harbor, Mich.; Deming Co., Salem, Ohio; Spraymotor Co., London, Ont. Hog scalders, steam food cookers, boilers, etc., may be secured through the Griffith & Turner Co., Baltimore, or doubtless from the following manufacturers: Marvin Smith Co., Chicago, Ill.; Electric Wheel Co., Quincy, Ill.; Crook & Horner Co, Baltimore, Md.; Thos. C. Basshor Co., Baltimore, Md. Where orchards of any considerable size are to be treated, the writer believes it will be economy in the long run to purchase a boiler, so that the cooking may be done by steam. While the initial cost will be greater, there will be a saving in time and labor and the wash is more likely to be better prepared than in open scalders or pots.

COST OF WASH.

The average cost of materials in each gallon of lime, sulfur and salt wash will be about one-and-one-half cents. It may vary somewhat below this, or some what above, depending on the opportunities of the individual to buy the different materials. Sulfur is the most expensive ingredient. In some cases, *flowers of sulfur* is indicated in the formulas recommended. There appears to be no reason why *flour sulfur* will not be equally satisfactory, and this grade is somewhat cheaper, as noted below.

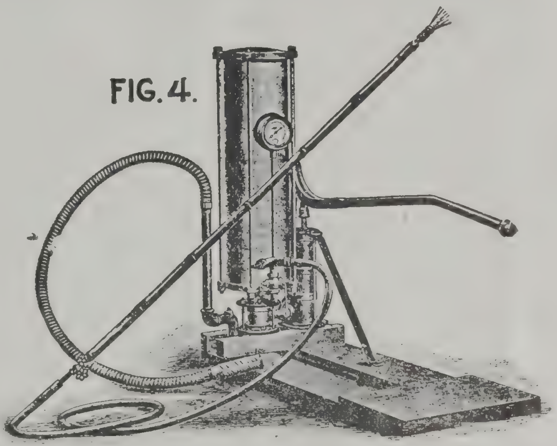


FIG. 4.

The Thomsen Chemical Company, of Baltimore, under date of January 9th, 1903, quote:

Flour Sulfur	250 lb. barrels at	$2.40 per 100 lbs.
“ “	175 “ “ “	$2.50 “ “ “
Flowers of Sulfur	150 “ “ “	$2.60 “ “ “

f. o. b. Baltimore.

Quotations from both the Bergen Port Sulphur Works, and Battelle and Benwick, under date of January 12th, 1903, both firms in New York City, are:

Flour Sulfur	250 lb. barrels at	$2.35 per 100 lbs.
“ “	175 “ “ “	$2.45 “ “ “
Flowers of Sulfur		$2.55 “ “ “

f. o. b. New York.

The cost of one-and-one-half cents per gallon, does not include the cost of feul, labor or any part of the outfit needed in its preparation and application. And it should be noted that more of the wash is required to secure a thorough coating of the trees than in the case of the oils. It will, however, be cheaper than the oil treatment, particularly at present prices of oil and much cheaper than the whale oil soap solution It's principal advantages are, however, it's effectiveness and the safety with which it may be used.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 45. JANUARY, 1903.

DIRECTIONS FOR THE TREATMENT OF TREES AND PLANTS INFESTED WITH THE SAN JOSE SCALE.

By A. L. Quaintance, State Entomologist.

In the present paper will be found directions for the preparation and use of the three or four best insecticides for the control of the San Jose Scale.

General Remarks.

If trees are quite badly infested, they should in most cases be at once dug up and burned. Such trees are usually too seriously injured by the scale to make it worth while to attempt to save them. The question of the vitality of the trees should be carefully considered in determining the plan of action. A very severe pruning of the infested trees followed by a thorough spraying will frequently give satisfactory results, particularly if in addition the trees receive good fertilization and cultivation. Good judgment must be exercised in determining whether it is better to destroy an orchard or to attempt to save it by the destruction of the scale with sprays. Where infested trees have been found here and there in an orchard, the scale is in all probability much more generally distributed than an inspection would indicate. Under these circumstances, it would be better to spray the entire orchard, and in any case, spraying should not be confined to trees seen to be infested, but all those in the immediate neighborhood should be treated. As a rule, spraying is not done with sufficient thoroughness to secure the best results. It should always be borne in mind that the scale is not killed unless actually hit by the spray mixture. Special pains therefore should be taken that every part of the tree, from the crown to the top-most branches, be treated. When rather high trees are to be sprayed, an extension pole is necessary, by which means, the nozzle may be elevated sufficiently high to spray the higher parts of the tree. Much inferior work has also resulted from the fact that the hose leading from the spray pump has not been of sufficient length. For a barrel pump, the hose should be at least 20 or 25 feet long. A hose of such length will enable the sprayer to get quite around an average orchard tree, with the wagon standing between the rows, and finish the tree before leaving it. The work is thus likely to be much more thorough than if but one side of the tree is sprayed at a time, as is necessary with a ten-foot hose. A barrel pump is much the most satisfactory size for orchard use, as it is possible to secure the necessary force for thorough work.

(1). Lime, Sulphur and Salt Wash.

Experiments in many of the Eastern States the past year indicate that this is a most efficient spring treatment for the San Jose scale. The wash may be made according to the following formula:

Best Unslacked Lime	30 pounds.
Flour Sulphur	15 pounds.
Stock Salt	12 pounds.
Water to make	50 gallons.

Directions.—Place ten pounds of lime and all of the sulphur in a boiler containing twenty gallons of water, and boil over a brisk fire for not less than one hour and a-half, or, until the sulphur is thoroughly dissolved. When this takes place the mixture will be of an amber color. Next, place in a cask twenty pounds of unslacked lime, pouring over it enough hot water to thoroughly slack it, and, while it is boiling, add the twelve pounds of salt. When the salt is dissolved, add the lime and salt mixture thus prepared to the lime and sulphur in the boiler, and cook for half an hour longer when the necessary amount of hot water to make the fifty gallons should be added.

This formula, it will be observed, is reduced from the standard formula given, to the amount of materials required for fifty gallons of wash, since this is the amount required to fill an ordinary barrel spray pump. In pouring the wash into the barrel, it should be well strained, to remove any particles of lime that may not have dissolved, and a fine wire strainer should be used. This wash may be more conveniently cooked by the use of steam, where a steam engine of any kind is available. Many orchardists could doubtless afford to purchase small, steam boilers, as steam food-cooking boilers, for the preparation of this wash. A boiler may be secured of sufficient size to cook two or three barrels of the wash at the same time, at a cost of from thirty to forty dollars. Best results will come from the use of the wash if applied to the trees in the spring, somewhat before the buds begin to swell. It is a very caustic treatment, and consequently can be used on trees only when in a practically dormant condition. In addition to being a most efficient insecticide, the lime, sulphur and salt wash is stated to be very effective in controlling peach leaf curl. This is probably the cheapest treatment for the scale at present available, but it should be understood that it is somewhat troublesome to make and to apply. The barrel "Pomona," "Century," "Peerless," and "Eclipse" spray pumps are all excellent for the application of this wash. It is essential that the pump have a strong agitator, otherwise the sediment will be inclined to settle on the bottom of the barrel.

(2). Whale Oil Soap.

This is a most satisfactory substance to use against the San Jose Scale, but its cost has doubtless prevented its more general adoption. Where a few trees are to be treated or washed, the whale oil soap is to be preferred from the fact that it may be secured and kept in any desired quantity, and is so readily prepared. It is dissolved in hot water and may be applied in the form of a spray as are other washes, or where practicable, be painted on the trees with a brush, or scrubbed on with a cloth. On pear and apple trees the soap solution should be used at the rate of two pounds to each gallon of water, and may be applied any time during the winter. For peach and plum, however, it should be used at the rate of one and one-half pounds of soap to the gallon of water, and it should not be applied until shortly before the buds begin to swell in the spring. There are several brands of whale oil soap on the market, but we have found Good's potash whale oil soap No. 3, manufactured by James Good, 939-941 North Front Street, Philadelphia, Pa., to be most satisfactory, and dissolving sufficiently to be readily sprayed while warm at the rate of two or even three pounds of soap to the gallon of water. In any event, a potash soap should be purchased as the soda soaps are likely to become more or less solidified when cold, and hence cannot be used in spray pumps. Good's potash whale oil soap may be purchased of the manufacturer at from three to five cents per pound, depending on the quantity ordered.

(3). Kerosene.

Ordinary illuminating or coal oil, in 20 per cent. mechanical mixture with water is being quite largely used at the present time against the scale. It has proven satisfactory, on the whole, in Western Maryland, where, at the present time, it is probably the main reliance. From several localities on the Eastern Shore and the tide water section generally, there has come complaint of severe injury to the trees treated. Kerosene, therefore, should be used with considerable caution, and where past experience has shown it to be injurious, the lime, sulphur and salt wash, or whale oil soap should be substituted. One of the serious difficulties in the use of kerosene, in mechanical mixture with water, is the fact that the "kerowater" pumps, thus far put on the market, have been more or less unreliable; that is, many of the pumps fail to discharge the desired per cent. of oil as indicated by the "set." It thus results that the trees may be injured by an excessive per cent. of oil, or, on the other hand, the per cent. may not be sufficiently high to be effective against the scale. In using any pump, making the mechanical mixture of kerosene and water, it should be tested from time to time, by spraying some of the mixture in an ordinary, cylindrical, fruit jar. After allowing the jar to stand for a while, the oil will have separated to the top of the water, and the per cent. may be readily determined by the use of a rule. For the use of kerosene in mechanical mixture with water, we have found Gould's "Kerowater" pump to be the most reliable of any thus far tested.

(4). Kerosene Emulsion.

Any desired per cent. of kerosene in a wash may be accurately secured by making a kerosene emulsion. The 20 per cent. kerosene emulsion in quantities of fifty gallons should be made up as follows:

Water	5	Gallons.
Ordinary hard soap	1½	Pounds.
Kerosene (150 degrees)	10	Gallons.

Pour ten gallons of kerosene in the spray pump barrel. Slice the soap and dissolve in the water, which should be heated to the boiling point. Pour the hot water into the spray pump barrel, and thoroughly emulsify by pumping the mixture back into itself for ten or twelve minutes, moving the nozzle around all the while. The emulsion, when properly made, should be of a creamy-white consistency, and may be diluted with any desired quantity of water without the oil separating to the top. If thirty-five gallons of water, making fifty gallons in all, are added, there will be a twenty per cent. kerosene emulsion. This may be used instead of kerosene in mechanical mixture with water, as mentioned above. This is an effective spring treatment for the San Jose scale, and should be applied before the buds open in the spring. Kerosene emulsion may be applied with an ordinary spray pump, such as the one used for the lime, sulphur and salt, or it may be painted or rubbed on infested trees as mentioned for whale oil soap. Where it is desired to make a less quantity than indicated, the formula may be reduced, by simply observing the proper proportions.

Kerosene emulsion may also be used as a summer treatment on trees or plants infested with the San Jose scale, but should be applied on bright, sunshiny days. In our experience, no injury has resulted to trees so treated.

(5). Spray Pump Manufacturers.

Before buying a spray pump, get catalogs of the following firms, and order the pump best suited to your needs: Griffith & Turner, Baltimore, Md.; Morrill & Morley, Benton Harbor, Mich.; Deming Co., Salem, Ohio; Bean Chamberlain Mfg. Co., Hudson, Mich.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION

STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 43. OCTOBER, 1902.

PEACH YELLOWS.

By J. B. S. Norton, State Pathologist.

NATURE AND SYMPTOMS.

Yellows is a distinct disease, attacking peach trees and also almond, apricot and Japanese plum. The fruit of trees so diseased ripens prematurely, is covered with red spots extending into the flesh, and is usually insipid or bitter. Later, small, abnormally narrow, yellow leaves appear, often in clusters on slender twigs from prematurely developed leaf buds. The trees soon cease bearing, and in a few years die. Yellow foliage is not necessarily a symptom of this disease, but may be due to various forms of starvation, borers, crown gall, etc. Most of the many causes conceived for the disease have been disproved by careful investigation. It certainly is communicable from one tree to another, and is largely spread from nurseries through the use of buds and seeds from diseased trees. It also without doubt spreads from tree to tree in orchards by means of pollen, insects or some unknown method.

DISTRIBUTION IN MARYLAND.

Yellows occurs in Prince George, Anne Arundel, Queen Anne and Caroline counties, and all of the State north and west of these. It is especially bad in the northern counties, where the peach industry is not well developed, and care has not been taken to destroy diseased trees.

TREATMENT.

No treatment for yellows has proved at all effective, except the one now generally practiced: Digging up and burning the diseased trees. Thorough watch should be kept, whenever going through the orchards, for the first symptoms, and trees showing premature, red-spotted fruit, or other indications of this disease should be immediately dug up and burned on the spot. It is better to destroy suspected trees than to let them remain. New trees may be planted where the diseased trees were taken from without contracting the disease.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 42. AUGUST, 1902.

INSTRUCTIONS RELATING TO NURSERIES.

By A. L. Quaintance, State Entomologist,
and J. B. S. Norton, State Pathologist.

This bulletin contains information regarding the nursery inspection law of Maryland and the kindred laws of other States, Territories and Countries, and the requirements and recommendations of the State Entomologist and State Pathologist, both to nurserymen and their patrons, regarding the growing and shipping of nursery stock, with special reference to injurious insects and plant diseases. The subject matter is divided into the following parts:

Part I.—Instructions to Maryland Nurserymen.
Part II.—Instructions to Brokers and Dealers.
Part III.—Instructions to Patrons of Maryland Nurserymen.
Part IV.—Instructions to Nurserymen outside of Maryland.

PART I.—INSTRUCTIONS TO MARYLAND NURSERYMEN.

The present year the inspection of nurseries will be made as rigid as possible, and wherever any injurious insects or diseases are detected on the growing stock or on the premises, such must be thoroughly eradicated before a certificate will be given.

Certificates of inspection the present year will cover freedom from the San Jose scale, wooly aphis of the apple, the strawberry root louse, peach yellows, crown gall, fire blight and black knot. In the case of the wooly aphis of the apple, the strawberry root louse and crown gall, which pests are likely to be more or less present in any nursery, a statement will be required from nurserymen where these pests may be found to the effect that stock infested with either of these insects or crown gall will not be sent out to customers, but will be carefully sorted out and destroyed. This is the most feasible method of restricting the distribution of these affections that has occurred to us, as it is manifestly impossible to destroy every affected tree or plant in the course of nursery inspection, from the fact that to determine whether it is infested or not, it must first be pulled up. It should be stated that most of our nurserymen voluntarily discard all trees showing the presence of the root aphis or crown gall, and this requirement will not come as a hardship to them. Any wilful violation of this agreement will be considered as cause for the withdrawal of our nursery certificate. Under the head of "Instructions to Patrons" on a later page of this bulletin, the attention of the tree-buying public will be called to this restriction in the hope that any cases of violation will be reported to us. It is far from the wish of the officers in charge of this work to make any requirements not entirely warranted by the nature of the case. Several states have already made such restrictions in the case of the wooly aphis of the apple or crown gall, and it is probable that other states will soon follow this example. This requirement, in addition to fumigation, will, it is believed, practically prevent the dissemination of these pests.

The practice of carrying over the odds and ends of last year's stock healed-in in the yards or elsewhere cannot be too strongly condemned. It is possible in this way that serious insects or diseases may become established. This danger is particularly great if stock from other parts of the country are thus held over in the hope of a possible sale. Such trees are not usually in good condition, and will not, as a rule, prove satisfactory to a discriminating purchaser. Each spring, after the season's shipments are over, the yards should be given a thorough cleaning up, and all remnants can be most profitably disposed of by placing them in the fire.

Another point which should receive careful attention is the destruction of all fruit and other trees from the immediate neighborhood of the nursery fields that are at all likely to harbor insects and diseases. When nursery pests become established in such trees, they prove a constant source of infestation to the growing stock, and must occasion serious loss. Nursery fields should be free, as far as possible, from fruit trees, cedars, wild cherry, sumach, hawthorn, walnut and the like.

In another paragraph will be found descriptions of the several pests prescribed as dangerously injurious, and all growers of nursery stock are urged to thoroughly familiarize themselves with the characters and symptoms of these insects and diseases. Under present conditions, where there is so much of buying and exchanging of stock among nurserymen themselves to enable them to fill orders, it will be only by close attention that the exclusion of these pests will be possible.

While the practice of fumigation among nurserymen throughout the country at large is deservedly growing, yet, it has not become universal, and no seedling stock, buds, grafts or cuttings from outside sources should under any circumstances be planted or used until they have been properly subjected to the treatment with hydrocyanic acid gas. In fact, it is much to be recommended that all buds, grafts or cuttings used for purposes of propagation, even though grown on your premises, be fumigated before being used. This will be an extra safeguard, and no pains should be spared to remove any possibility of the establishment of any of these pests.

It is planned to begin the work of nursery inspection about the middle of August. A certificate issued on an inspection made before this date would manifestly be of little value, since in the case of the San Jose scale for instance, there would yet be time for two or three broods of the insect and consequent dissemination before the cold weather or fall. The inspections to be of the most value should be made as late as possible, but the extent of the nursery industry in Maryland necessitates that work should be begun not later than the date set in order that the inspections may be completed in time for the fall trade.

The officers of the State Horticultural Department desire to most heartily commend the nurserymen of Maryland for the hearty cooperation they have extended in our efforts to fulfill the requirements of the inspection law. There has been a marked improvement in the condition and healthfulness during the past year, and we have no hesitation in saying that in our opinion the conditions of the nurseries of Maryland are in no way inferior to those of any state in the East.

CERTIFICATE.

The following form of certificate is issued to nurserymen, whose premises and stock are free from injurious insects and plant diseases:

CERTIFICATE OF NURSERY INSPECTION.

No..............

TO WHOM IT MAY CONCERN:

THIS IS TO CERTIFY, That on the..............day..........of ....190.......we examined the Nursery Stock of .... growing in ....nurseries at.....................................County of.............State of Maryland, in accordance with the laws of Maryland, 1898, Chapter 289, Section 58, and that said nurseries and premises are apparently free, so far as can be determined by inspection, from the San Jose Scale, Peach Yellows, Pear Blight and other dangerously injurious insect pests and plant diseases.

This certificate is invalid after................................190...... and does not include nursery stock not grown within this State, unless such stock is previously covered by certificate and accepted by the State Entomologist and State Pathologist.

....
State Entomologist.

....
State Pathologist.

College Park, Md.,...................190....

MARYLAND NURSERY LAW.

The following sections of Laws of Maryland 1898, chapter 289, refer directly to Maryland Nurserymen, and are here inserted for their information and guidance.

"§58. That it is hereby also made the duty of the said board of trustees [Maryland Agricultural College], through the State Entomologist and the State Pathologist, or their duly authorized assistants, to inspect at least once in every six (6) months, all nurseries of trees, vines, shrubs and plants, subject to the aforesaid insects or diseases [San Jose scale, peach yellows, pear blight and other injuriously dangerous insect pests and plant diseases] within the State, and if found free so far as can be determined by inspection, from the aforesaid insects or diseases, to give to the owner or owners or persons in charge of said nurseries a certificate of inspection showing such nurseries or premises to be apparently free from such insects and diseases. If any of the aforesaid insects or diseases should be found in any nursery or orchard, or any premises within the state where nursery stock is grown, the aforesaid officers shall cause to be destroyed or treated such portion of such nursery stock or other trees or plants as in their opinion may be necessary, and shall release all other nursery stock grown upon said premises, and issue a certificate of inspection to the owner or owners as herein provided for; and if such infested or diseased trees, vines, plants or shrubs be destroyed by the aforesaid officers, then the owner shall pay the cost thereof, and if he refuse to pay the same it shall be collected as prescribed in section 56. No nurserymen, broker, agent, dealer or other person shall be permitted to sell, ship, send out, or give away, by mail, express, freight or otherwise, any trees, vines, shrubs, plants, buds or cuttings from any such nurseries or premises, without accompanying the same with a copy of the said certificate printed upon a tag or label not easily destroyed, the same to be firmly attached in some conspicuous position upon each car load, box, bale or package so sent out or delivered.

"§59. That should any nurseryman, agent, broker, dealer or other person send out or deliver within the State, or transport to any other State or Territory or the District of Columbia, trees, vines, shrubs, plants, buds or cuttings, subject to the attacks of insects and diseases above provided for, without attaching a copy of said certificate, deface or destroy said certificate, or wrongfully attach a certificate, he shall be adjudged guilty of a misdemeanor, and shall upon conviction, before any justice of the peace, be fined a sum not less than ten dollars ($10) or more than one hundred dollars ($100) and cost of prosecution for each and every offence, and stand committed until such fine and costs are paid, and the fines so collected shall be paid to the trustees of the said college and be added to the funds herein provided for carrying out the provisions of this Act.

"§59A. That all trees, plants, vines, shrubs, buds or cuttings, commonly known as nursery stock, grown or handled by each and every nurseryman within this State, and subject to the attacks of the aforesaid insects or diseases shall be fumigated by the nurseryman owning the same with hydrocyanic acid gas in buildings or inclosures inspected and approved by the aforesaid State officers under their discretion."

A BRIEF SYNOPSIS OF LAWS AND REGULATIONS OF OTHER STATES AND TERRITORIES WITH PARTICULAR REFERENCE TO THE REQUIREMENTS FOR THE ADMISSION OF NURSERY STOCK.

ALASKA.—No regulations concerning the transportation and admission of nursery stock seem to be in force. Mr. Fred. E. Rader, Acting Special Agent in charge of Alaska Investigations, Sitka, Alaska, should be addressed if any information is desired.

ALABAMA.—This state has no law in reference to inspection and transportation of nursery stock.

ARIZONA.—There is no nursery inspection law in this territory.

ARKANSAS.—There are no regulations relative to the inspection of nursery stock in this state. Prof. Ernest Walker of the State Agricultural Experiment Station, Fayetteville, has furnished certificates to Arkansas nurserymen when needed by them to secure admission of stock into states where certificates are required.

CALIFORNIA.—Shipments of nursery stock, etc., into this state are inspected upon arrival by the State Quarantine Officer, Mr. Alexander Craw, San Francisco, who must be notified of the receipt of shipments upon its arrival.

COLORADO.—County Inspectors appointed by the State Board of Horticulture must examine all shipments of nursery stock into this state before delivered and disinfect or destroy the same as conditions may require.

CONNECTICUT.—Nursery stock shipped into this state must be accompanied by a certificate of inspection. Prof. W.E. Britton is State Entomologist and should be addressed at New Haven.

DELAWARE.—A certificate of fumigation by the grower or shipper must be attached to each package of nursery stock shipped into this state. Mr. Wesley Webb, Dover, is State Inspector.

FLORIDA.—No certificate of nursery inspection seems to be required for shipments of stock into this state. Certificates have been issued to Florida nurserymen by Prof. H. A. Gossard, Entomologist of the Agricultural Experiment Station, Lake City, upon request.

GEORGIA.—Nurserymen outside of Georgia, who desire to do a business in the state, must file a copy of an accredited certificate of inspection with the State Entomologist, W. M. Scott, Atlanta, Ga. Upon receipt of this certificate, official tags will be issued by the State Entomologist of Georgia, which should be attached to every package shipped into the state. These tags will be furnished at a cost of sixty cents for the first hundred and twenty-five cents for each additional hundred.

IDAHO.—Nursery stock not grown in this state is prohibited from sale or distribution until examined by the Inspector. If found diseased, the same shall be disinfected. All packages shipped into the state should bear a label indicating the character of the shipment, name of shipper and locality where grown. Trees subject to yellows are not admitted to the state from districts where yellows exists.

ILLINOIS.—All shipments of nursery stock into this state must bear name of consignor and certificate of inspection of current year's date. Prof S. A. Forbes, Urbana, is State Entomologist.

INDIANA.—Packages of nursery stock shipped into this state must bear a certificate of inspection signed by a state or government inspector. Prof. James Troop, Lafayette, is State Entomologist.

IOWA.—When nursery stock is shipped into this state accompanied by a certificate of nursery inspection, this shall be held as *prima facie* evidence of the facts therein stated. It is unlawful to make shipments of stock into the state unless accompanied by proper certificate. Prof. H. E. Summers, Ames, is State Entomologist.

KANSAS.—There seems to be no law governing the inspection or transportation of nursery stock. Prof. E. A. Popenoe, Manhattan, has issued certificates of inspection to Kansas nurserymen as desired.

KENTUCKY.—Shipments of stock into this state must be plainly labelled, showing the name of the consignor, the consignee and contents, and must bear certificate, showing that stock has been inspected, and has been found free from insect pests and fungus diseases. Prof. H. Garman, Lexington, is State Entomologist.

LOUISIANA.—All fruit trees, etc., brought into the state must be labelled with name of owner or grower and locality where grown and shall be subject to inspection by the Entomologist of the State Experiment Station.

MAINE.—There seems to be no law in reference to the certification and transportation of nursery stock.

MARYLAND.—All nursery stock shipped into this state must bear a copy of an accredited certificate of nursery inspection. All nurseries in the state must be inspected and a certificate issued when found free from injurious insects and diseases. Nurserymen in the state are required to fumigate all stock before shipping. A. L. Quaintance, State Entomologist and J. B. S. Norton, State Pathologist, College Park.

MASSACHUSETTS.—A certificate of nursery inspection must accompany each shipment into this state. H. T. Fernald, Amherst, is the State Inspector.

MICHIGAN.—Nursery stock shipped into this state must be plainly labelled with the names of the consignor, the consignee and contents and must bear a certificate of nursery inspection. D. W. Trine of Lansing, is State Inspector.

MINNESOTA.—This state has no law governing the inspection and transportation of nursery stock. Certificates of inspection are issued to nurserymen in the state by the State Entomologist, F. L. Washburn, St. Anthony Park, St. Paul.

MISSISSIPPI.—There seems to be no regulations in this state concerning the inspection and transportation of nursery stock.

MISSOURI.—Shipments from outside of the state must be labeled with the name of the consignor, consignee and contents, and bear a certificate showing inspection by a State or Experiment Station Entomologist. For further information address George B. Ellis, Secretary State Board of Agriculture.

MONTANA.—In this state, it is required that all nursery stock before delivered to the purchaser, shall be unpacked and fumigated at certain points along the various railways. For particulars address, C. H. Edwards, Secretary of State Board of Horticulture, Missoula.

NEBRASKA.—This state has no law governing the inspection and transportation of nursery stock.

NEVADA.—There is no law governing the inspection and transportation of nursery stock.

NEW HAMPSHIRE.—No law in reference to the certification and transportation of nursery stock.

NEW JERSEY.—In order to ship nursery stock into this state, each package must bear a copy of a certificate obtained from the proper state or government authorities where stock was grown, stating that stock has been properly inspected not more than six months before shipment and found free from San Jose scale or other dangerous insects. Dr. J. B. Smith is State Entomologist at New Brunswick.

NEW MEXICO.—There seems to be no law governing the transportation of nursery stock in this state.

NEW YORK.—Certificates of nursery inspection are issued to nurserymen by C. A. Wieting Commissioner of Agriculture, Albany. Transportation companies within the state are required to notify the Commissioner of Agriculture, Albany, N. Y., when shipments of nursery stock are received from points without the state, giving name of consignor, consignee and destination. All nursery stock shipped into the state must be subjected to fumigation. When done by the consignor, a certificate should be attached, indicating this fact.

NORTH CAROLINA.—No transportation company shall deliver nursery stock from within or without the state unless each package bears a label stating the name and address of grower together with an official certificate of nursery inspection. Nurserymen outside of the state must send copy of their certificates to the North Carolina Department of Agriculture, Raleigh, and one hundred tags will be sent them to tag the stock. One of these tags must be attached to each shipment. The first one hundred tags are furnished free, but all over this at forty cents per one hundred. Franklin Sherman, jr., Raleigh, is State Entomologist. Nursery stock subject to yellows is not admitted from any region known to be infested with the yellows.

OHIO.—Every package of nursery stock shipped into this state must be plainly labeled with the name of the consignor and consignee and bear a copy of an official certificate of nursery inspection. A. F. Burgess, Columbus, is General Inspector.

OKLAHOMA.—This territory has no law in reference to the inspection and transportation of nursery stock.

OREGON.—All consignees or other persons receiving shipments of nursery stock from without the state must within twenty-four hours notify the Quarantine Officer of the State Board of the arrival of same. Such nursery stock on arrival at the Quarantine Station must be inspected by State officers, who shall issue a certificate if stock is found free from insect pests or fungus diseases. Nursery stock subject to yellows is not admissable from regions where yellows exists. Further information may be had by addressing the State Board of Horticulture, Salem

PENNSYLVANIA.—Nursery stock shipped into this state must bear on each package the name of the consignor, the name of the consignee and a certificate of nursery inspection which shall be held as *prima facie* evidence of the facts therein stated. Certificates are issued by Mr. John Hamilton, Secretary of Agriculture, Harrisburg.

RHODE ISLAND.—This state has no law relating to the inspection and transportation of nursery stock. Certificates of inspection have been issued to Rhode Island nurserymen by Prof F. W. Card, Kingston.

SOUTH CAROLINA.—Persons without the state desiring to do business in South Carolina, must register their names and file a copy of their certificate of inspection with the Chairman of the Board of Entomology at Clemson College. Otherwise, shipments may be destroyed.

SOUTH DAKOTA.—There is no law in this state governing the transportation of nursery stock. Certificates have been issued to nurserymen by Prof. D. A. Saunders of the State Agricultural College, at Brookings.

TENNESSEE.—Shipments of nursery stock from other states must bear a copy of certificate of nursery inspection. The State Entomologist should be addressed at Nashville.

TEXAS.—There seems to be no law in this state pertaining to the certification or transportation of nursery stock.

UTAH.—All persons receiving shipments of nursery stock from points outside of the state shall notify the County Inspectors, who shall examine the same. J. A. Wright, Logan, is Secretary of the State Board of Horticulture.

VERMONT.—This state has no inspection law. Certificates have been issued to Vermont nurserymen by the Entomologist of the Agricultural Experiment Station, Burlington.

VIRGINIA.—All shipments of nursery stock from without the state must bear a certificate of inspection. In addition an official tag furnished by the Virginia State Entomologist is required. This tag is furnished on certificates of inspection to be filed with the State Entomologist of Virginia and the tags are issued if this certificate is found satisfactory. These official tags will be furnished on application at the following prices: twenty-five tags twenty cents, fifty tags twenty-five cents, one hundred tags thirty cents, two hundred and fifty tags sixty-five cents, five hundred tags ninety-five cents, one thousand tags one dollar and fifty cents, postpaid. Payment should be made by postal order in advance to W. B. Alwood, State Entomologist and Pathologist, Blacksburg.

WEST VIRGINIA.—A certificate of nursery inspection is required on each shipment of nursery stock into this state. The inspection work is in charge of the Director of the Experiment Station at Morgantown.

WISCONSIN.—Nursery stock shipped into this state must bear a certificate, stating that it has been properly inspected and found free from San Jose scale, etc. The inspection work of the state is in charge of W. A. Henry, Director of the Agricultural Experiment Station at Madison.

WYOMING.—There seems to be no legislation relating to nursery stock in this state.

CANADA.—Importations of nursery stock are permitted to enter at the custom ports only of St. John, N. B., St. Johns, Quebec, Niagara Falls and Windsor, Ontario and Winnepeg, Manitoba, between the 7th of October and the 7th of December in the fall, and between the 15th of March and the 15th of May in the spring. Stock will be admitted at Vancouver, B. C., only from the 15th of October to the 15th of March each year. At these ports, stock must be thoroughly fumigated by a government official with hydrocyanic acid gas. Packages to enter Canada must be addressed to one of the ports named. Immature stock or stock too far advanced for treatment will be refused entry. If further particulars are desired, address Mr. John J. McGee, Clerk of Privy Council, Ottawa, Ontario.

FOREIGN COUNTRIES.—When it is desired to ship nursery stock to foreign countries, you are requested to correspond with this department in reference to the requirements of any particular country.

INSECTS PRESCRIBED AS DANGEROUSLY INJURIOUS.

(I). San Jose Scale.—This insect is very small, and may be readily overlooked, except by an experienced person. The mature female scale is approximately the size of a pin head, or may be somewhat larger, particularly where the individuals are more or less isolated, and thus have a better chance to develop. By the use of a hand lens, which every nurseryman should have, the female scale is seen to be of an ash grey color, circular in outline, somewhat conical and terminating at the top in a nipple-like prominence which is surrounded by a distinct line. By referring to Figure 1, a better idea of the insect may be obtained. The San Jose scale may occur on the following plants: peach, plum, apple, pear, apricot, cherry, quince, almond, rose, hawthorn, raspberry, spiraea, cotoneaster, prunus pissardii, strawberry, flowering quince, mountain ash, gooseberry, currant, flowering currant, grape, English walnut, pecan, black walnut, persimmon, elm, osage orange, linden, euonymus, weeping willow, Kilmornock willow, English willow, golden willow, cottonwood, Lombardy poplar, Carolina poplar, catalpa, sumach, silver maple and, perhaps, some others. In fact, it may be said that this species is practically omniverous, so far as deciduous plants are concerned, and the difficulty of its eradication after it has once become established is at once apparent.

In our inspection of nurseries last year, out of the forty-seven nurserymen in the State, forty-two were given certificates. The inspection revealed that in several cases, there was need of immediate work on the parts of the owners before certificates could be granted. In all, it was necessary to destroy stock probably to the valuation of $25,000.00. Despite this hardship to nurserymen, they have willingly followed our recommendations in the work of extermination, and at the present time there is every reason to believe that these nurseries are in a most excellent condition.

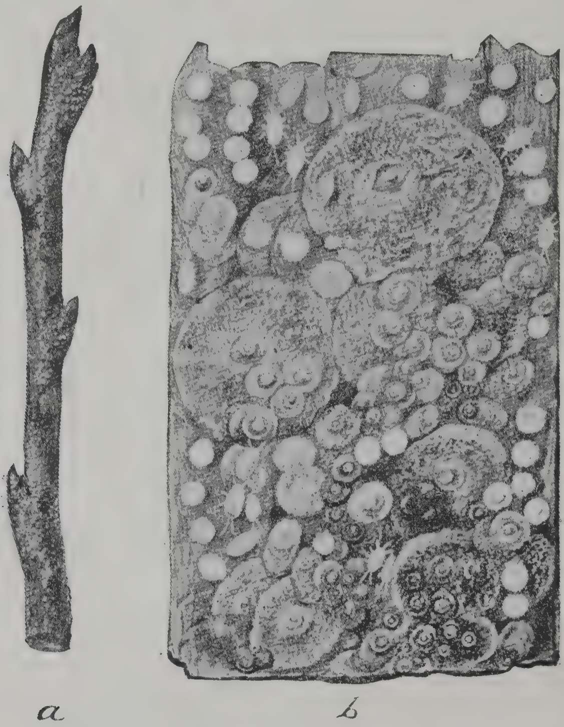

Figure 1.—San Jose Scale: a, infested twig; b, a view of infested bark magnified. (After Howard and Marlatt.)

Whenever it is noticed or suspicioned that this pest has appeared in any nursery, you should acquaint the department with this fact at once. Steps may then be taken to effect its eradication before it has spread to any extent. Prospective nurserymen should by all means consult with the department before selecting a location. In some sections of the State it would be decidedly unwise to embark in the nursery business, owing to the prevalence of the San Jose scale.

(II). The Wooly Apple Aphis.—This insect is illustrated in Figure 2, and the character of its injury to the apple roots is shown in Figure 3. The insects occur on the stem and twigs as well as on the roots of the apple, but it is particularly the root form to which attention of nurserymen should be called. Our observations concerning this pest warrants the statement that trees infested from a nursery when set out in the orchard will rarely grow in a satisfactory manner, and are likely to become permanently stunted, or may finally die outright. In the future, therefore, nurserymen will be required to discard all nursery stock sufficiently infested with the wooly aphis as to show knots or warts on the roots. In cases of slight infestation, where the insects have not caused the knotty condition of the roots, such stock may be sold from the fact that the pest will be exterminated by the process of fumigation.

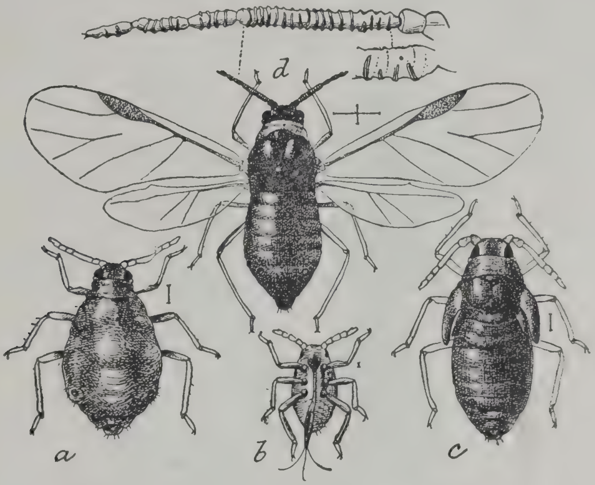

Figure 2.—The Wooly Apple Aphis: a, agamic female; b, larva; c, pupa; d, winged female. (After Marlatt).

Much may be done in the way of nursery management to secure comparative freedom from the wooly aphis. In the first place no seedling stock, whole, or piece-root grafts, should be planted from whatever source until they have been properly fumigated, not only on account of this insect, but other species as well. After the aphis becomes established in a soil, it is difficult to effect its eradication, hence the necessity of a system of rotation, such that the same land will not be replanted in apples without alternation with other classes of stock. Old apple trees in the neighborhood may serve as sources of infestation, and should be disposed with wherever possible.

The practice of spraying apple nursery stock occasionally during the growing season with whale oil soap solution, at the rate of one pound of soap to four or five gallons of water, as now done by some of our leading nurserymen, cannot be too strongly commended. Not only will the aerial form of the wooly aphis be destroyed as well as the aphis causing the curled and misshapened condition of the leaves, but the effect on the tree is most beneficial.

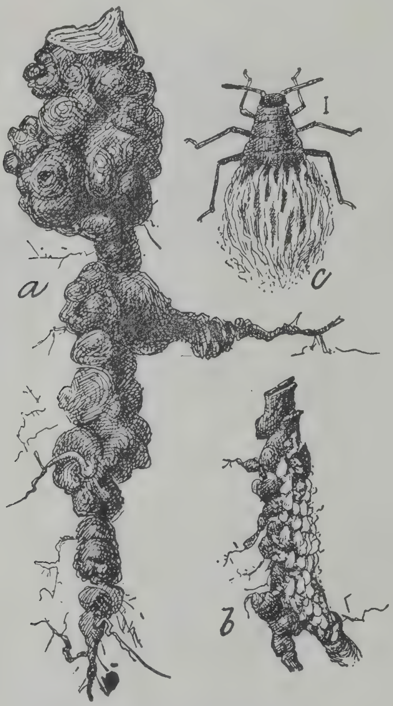

Figure 3.—Illustrating the work of the Wooly Apple Aphis on the roots: a, an apple root showing knots caused by the work of the insect: b, a colony of aphids on root; c; a louse. (After Marlatt).

(III). Strawberry Root Louse.—These insects are very small, being but about one-twentieth of an inch in length. The body is somewhat pear-shaped, tapering towards the head, and of a dark-bluish black color. The lice occur on both the roots and foliage, but injury is done particularly by the lice on the roots. Where numerous spots occur in the strawberry fields from which the plants have died, the presence of this aphid should be suspected. By pulling several plants and examining the roots, this can be readily determined. The lice occur in clusters along the roots. Ants are usually associated with the aphid, and construct numerous nests around the plant and among the plants infested.

So far as known, the strawberry root louse occurs only on the cultivated strawberry plant, and the work of controlling it thus becomes much easier than if it had a considerable number of food plants. To keep this pest from the nursery, clean plants must be planted on clean land. A system of frequent rotation should be followed, not planting the same land to strawberries, except after intervals of two or three years. All plants before being planted out should be subjected to the gas treatment. According to recent experiments in Delaware, but little, if any injury to plants will result by the use of two-tenths gram potassium cyanide per cubic foot for a period of forty-five minutes.

SOME OTHER SCALE INSECTS, WHICH, WHILE NOT DANGEROUSLY INJURIOUS, SHOULD NOT BE PERMITTED ON THE STOCK OR PREMISES OF NURSERYMEN.

(I). The Scurfy Bark Louse.—This scale insect is likely to be present in any apple orchard in the country. We have frequently found it on nursery stock where it had doubtless spread from such places. Many purchasers of trees not acquainted with the different species of scale insects may become alarmed at the presence of this or other scale, and a serious injury might thus result to your trade. The accompanying figure, Figure 4, illustrates this pest. The eggs are laid in the early fall, and occupy the greater part of the scale. The winter is passed in the egg condition, and the young hatch during the latter part of May or early June. To eradicate this and the other species of insects to be considered under this head, infested trees should be thoroughly sprayed with any of the ordinary insecticides recommended

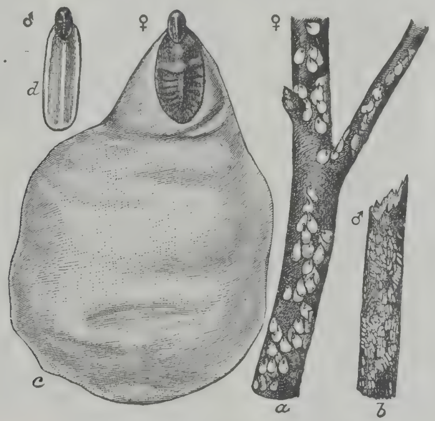

Figure 4.—The Scurfy Bark-Louse: a, b, infested twigs; c, female; d, male scale. (After Howard.)

against scale insects, such as whale oil soap, kerosene or crude petroleum emulsions.

(II). The Oyster Shell Bark Louse.—This is a common and widely- distributed species of scale, which at times becomes so abundant as to seriously injure infested trees. It occurs on the apple, peach, plum, pear, lilac and many other plants. It should have no place on the premises or stock of the wide-awake nurseryman. The insect is illustrated in Figure 5, from which it may be readily recognized. The insect passes the winter in the egg state, and the young hatch in May or early June, and crawl out on the twigs and small branches and there locate permanently. The insect may be most readily killed at this season of the year, and spraying infested plants as directed for the scurfy bark louse will enable anyone to keep this pest under complete subjection.

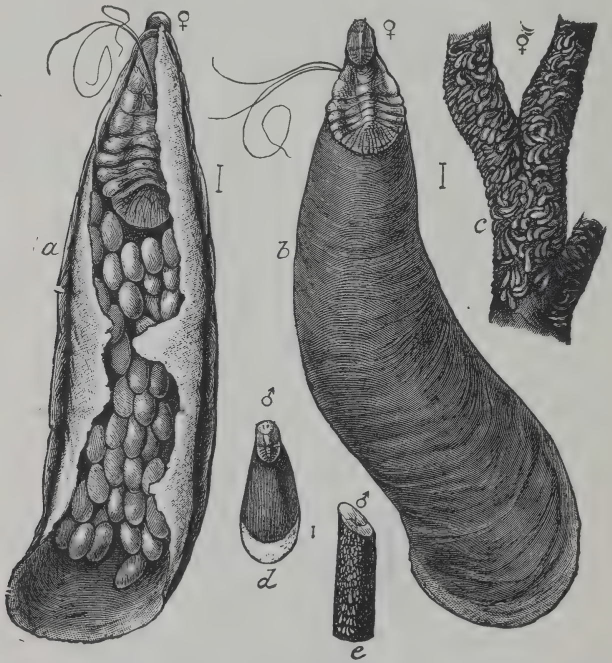

Figure 5.—The Oyster-Shell Bark Louse: a, b, females; c, scales on twigs; d, male scale. (After Howard).

(III). The Peach Scale.—This insect is illustrated in Figure 6. Owing to its white color it is sometimes known as the whitewash scale. This is a most serious pest of the peach in certain sections of the Southeastern United States, large orchards having been killed by it. So far as we are aware, the insect does not as yet occur in Maryland, but from the fact that it is very common on various shrubs and trees in the District of Columbia, and has already established itself in certain parts of Massachusetts, it is deemed desirable to call the attention of nurserymen to it. Should it ever be found or introduced in any nursery, energetic steps should be at once taken to effect its complete eradication, if possible. While it is not as injurious as the San Jose scale, yet it must be ranked as one of the most serious pests that has become established in this country.

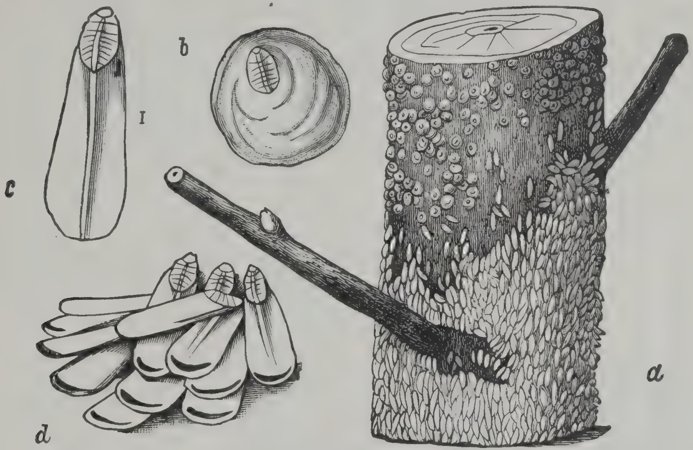

Figure 6.—The Peach Scale: a, infested branch; b, female; c, male; d, group of male scales. (After Howard)

(IV). The European Fruit Scale.—At the present time this insect, so far as known, is as yet established only in certain Northern States. It is a very serious scale insect of the orchard, and nurserymen should be on the lookout for it at all times. Its introduction in a nursery should be immediately followed by every effort to effect its extermination. The scale is shown in Figure 7. This species can be

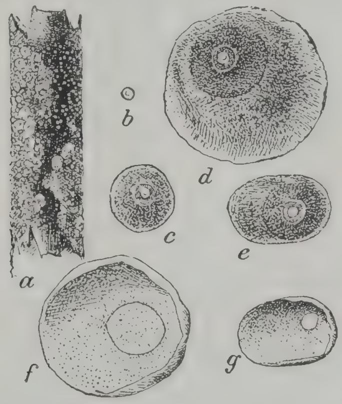

Figure 7.—The European Fruit Scale: a, scales on twig; b, natural size; c, immature stage; d, female; e, male; f, g, inside of scales. (After Marlatt.)

distinguished from the San Jose scale from the fact that the exuvium is orange or reddish colored, whereas in the case of the San Jose scale this is pale bluish or bark colored.

(V). The Peach Lecanium.—Not infrequently we have found this species present in orchards in such numbers as to prove seriously injurious to the infested trees. It may be recognized from the accompanying Figure 8. The insect is eliptical in outline, strongly convex, about one-fifth of an inch long, and about two-thirds wide. In color, it is usually dull greenish brown, and often more or less distinctly marked with dark bands. It is found principally on the peach and plum, but may also occur on the apple, occurring commonly on the underside of the twig or branch. Insects of the genus, to which this species belongs, exude a considerable quantity of honey due, a sweetish fluid upon which a black, sooty fungus occurs, and the presence of this scale on trees is usually indicated by the sooty or smoky appearance of the branches.

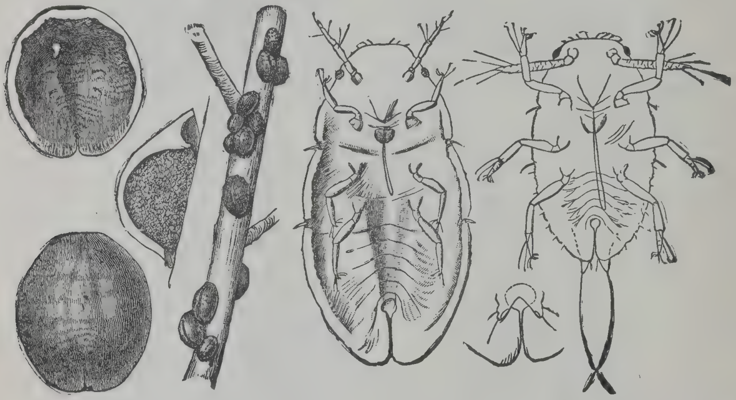

Figure 8.—The Peach Lecanium: adults at left, young at right. (After Howard).

The insects pass the winter in the adult condition and the young begin to hatch early in June, and continue to appear for quite a month. Remedial measures may be applied at any time during the winter, and also from the middle of June to the middle of July, at which time the insects, being in a larval condition, are more readily killed.

IMPORTANT NURSERY DISEASES.

(I). Fire Blight causes the twigs and leaves of peach, pear, apple, quince and related trees to die and blacken. Blighted twigs should be cut off several inches below the diseased portions and burned. The pruning knife used should frequently be disinfected in a strong solution of formalin or carbolic acid to prevent the germs of the disease being carried by it.

(II). Peach Yellows is undoubtedly disseminated from the nursery, and although the disease is present, it is rarely well developed enough to be distinguished in the nursery. The means of control lie in using pits from regions not infested with yellows, in the judgment of many best from seedling trees, and in using buds from orchards perfectly free from yellows. It is of the utmost importance to examine trees carefully before buds are taken to insure their perfect healthfulness and vigor. Even when apparently sound, they may convey yellows, then in an incipient stage, to trees budded from them. Yellows also attacks Japan plums, apricots, nectarines and almonds.

(III). Leaf Diseases, such as apple scab, apple leaf rust, peach leaf curl, and the various leaf spots of apple, cherry, pear, etc., can be controlled by spraying a few times in early spring and summer with Bordeaux mixture. The profit in increased growth and vigor of trees so sprayed was long ago demonstrated by many experiments.

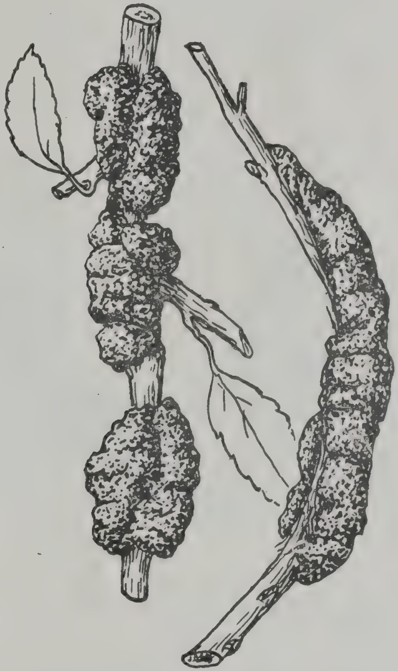

Figure 9.—Black Knot on Plum.

(IV). Grape Mildew, which often seriously retards the growth of cuttings in the nursery, can be prevented by spraying with Bordeaux mixture.

(V). Black Knot is a serious disease of cherries and plums, (Damson in particular). The large, rough, black excrescences on trees and branches are a good and easily recognized symptom. (See Figure 9). Knotted trees should be destroyed from the nursery. Fire is the best disinfectant for this and most other diseases. It should be used freely around the nursery. It is cheap and effective.

(VI). Anthracnose of blackberry and raspberry should be guarded against with great care in the nursery since the disease is difficult to eradicate. To those unfamiliar with it, it may be indicated by the scabby cracked spots on the canes.

(VII). Crown Gall is one of the worst diseases found in the nursery, and is easily recognized by the rough irregular, somewhat spherical outgrowths averaging an inch or less in diameter on the roots of young peach, pear, apple, plum, raspberry and other related plants. It usually occurs near the surface of the ground. In digging, trees infested in the least with these galls, should be discarded and burned. In no case should new nurseries be started on the ground infested with the gall since it is infectious and the germs remain in the ground sometime. (See Figure 10).

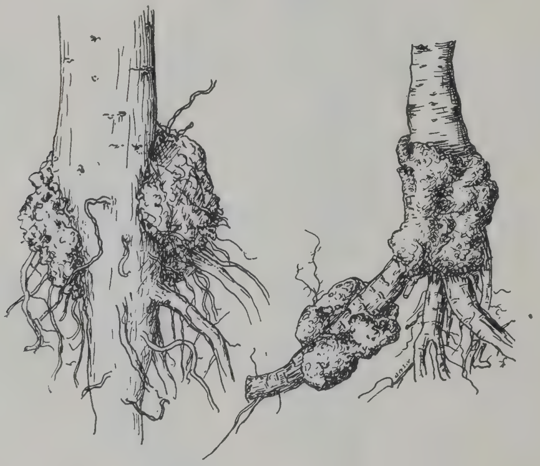

Figure 10.—Crown Gall: On the left on apple, on the right on peach

PART II.— INSTRUCTIONS TO BROKERS AND DEALERS.

Brokers or dealers in nursery stock in the state will be required to file with the State Horticultural Department a statement showing from what nurserymen they are obtaining or propose to obtain their stock. This is considered necessary to meet the requirements of the following clause in our certificate of nursery inspection: "This certificate is invalid after ————————, and does not include nursery stock not grown within this state, unless such stock is previously covered by certificate, and accepted by the State Entomologist and State Pathologist."

PART III.—INSTRUCTIONS TO THE PATRONS OF MARYLAND NURSERYMEN.

The purpose of the nursery inspection law is primarily to protect the interests of purchasers of nursery stock. To secure the best results in our efforts to guard your interests, we must have your cooperation, to the extent at least that you notify us when the sections of the law, relating to the certification and transportation of nursery stock, have been violated either by nurserymen within or without the state.

By reference to these sections as printed in this bulletin, the requirements may be readily determined. As has been stated, however, with but very few exceptions we have had no cause to complain of lack of cooperation on the part of Maryland nurserymen. As a whole, the gentlemen engaged in the nursery business in this state have evidenced the fact that they have the interests of the purchaser at heart and will spare no means to give entire satisfaction.

We have often been asked of prospective buyers of nursery stock whether such and such a nurseryman was free from insects and diseases. We have invariably stated that if the nurseryman in question had our certificate of inspection, without which it is unlawful for him to do business, this was the best guarantee we could give and that the possession of this certificate was to be accepted at its face value. It is our business to make a certificate stand for everything that is stated on it and none are issued until a strict compliance with its conditions have been met. The possession of a valid certificate of nursery inspection by any nurseryman in the state may therefore be held as evidence that his stock and premises, so far as we have been able to determine by a careful inspection, are entirely free from dangerously injurious insects and plant diseases. As an extra precaution, all nurserymen in Maryland are required to fumigate before shipment and where both inspection and fumigation are given, there is almost absolute assurance that the stock will be in a healthy condition.

PART IV.—INSTRUCTIONS TO NURSERYMEN OUTSIDE OF MARYLAND.

Section 60 of the State Law plainly defines the requirements of nurserymen or dealers outside of the state and is here inserted for their information.

"Section 60. That when any trees, plants, shrubs, vines, buds or cuttings commonly known as nursery stock are shipped into this State from any other State or Territory, or the District of Columbia, to any nurseryman, broker, dealer, agent or other person in this State, every carload, bale, box or package thereof shall be plainly labelled on the outside with the name of the consignor, the name of the consignee, and a certificate showing that the contents have been inspected by a qualified State or government officer, and that the trees, plants, vines, shrubs or cuttings therein contained are apparently free from the insects and diseases herein provided for. Whenever any trees, plants, vines, shrubs, buds or cuttings are shipped into this State from any other State or Territory, or the District of Columbia, without such certificate plainly fixed on the outside of each carload, box, bale or package, the agent of the transportation company, firm or person receiving same shall not deliver said nursery stock to the consignee or agent representing the consignor, and said agent of the transportation company, firm or person, shall notify the State Entomologist or State Pathologist at the Maryland Agricultural College, and said State officer receiving such notification shall immediately notify any justice of the peace of this State to issue a summons for the consignee, and the agent or consignor, if he be known, of such carload, bale, box or package of nursery stock, to appear before him on a certain day to be named therein, to show why such trees, plants, vines, shrubs, buds or cuttings should not be seized as being in violation of the provisions of this Act, and on trial thereof, if said justice be satisfied that the provisions of this Act have been violated, said justice shall order said agent or consignee to return such carload, box, bale or package of trees, plants, shrubs, vines, buds or cuttings immediately to the shipper or consignor, unless said consignee or agent of the consignor at his expense, shall forthwith have said nursery stock examined by the State Entomologist and the State Pathologist of this State, and said officers certify to such justice of the peace that said nursery stock is apparently free from the insects and diseases mentioned herein, and tag every such carload, box, bale and package inspected by said officers, with their certificate of inspection, and if said agent or consignee shall fail to have said nursery stock examined by said State officials, or fail to return such carload, box, bale or package thereof, then said justice of the peace shall order and direct the constable or sheriff to burn and destroy all such trees, plants, shrubs, vines, buds or cuttings that have been shipped into this State in violation of this Act."

All nurserymen who desire to do a business in this state should file with the State Entomologist, before November 1, a copy of their nursery inspection certificate. While this is not required by law, we desire these certificates to determine, as far possible, by whom the inspections were made. No tags from this department are necessary on shipments into the state. Simply attach copy of your certificate of nursery inspection, and shipments will be delivered by our transportation agents. It is not desired to in any way restrict the commerce of outside nurserymen in this state, but any violation of the above section will be immediately dealt with.

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THE MARYLAND
AGRICULTURAL EXPERIMENT STATION.
STATE HORTICULTURAL DEPARTMENT.

CIRCULAR BULLETIN No. 41. AUGUST, 1902.

LAW PROVIDING FOR THE SUPPRESSION AND CONTROL OF INSECT PESTS AND PLANT DISEASES IN MARYLAND.

LAWS OF MARYLAND, 1898. CHAPTER 289.

AN ACT to repeal sections 51, 52, 53, 54, 55, 56, 57 and 58 of Article XLVIII of the Code of Public General Laws, title "Inspection," sub-title "Trees and Nursery Stock," as designated by Chapter 290 of the Acts of the General Assembly of Maryland of 1896, and to re-enact the same with amendments, under a new sub-title, to be known as "State Horticultural Department," and to add thereto eight new sections, to be designated 59, 59 A, 60, 61, 62, 63, 64 and 65, providing for the protection of the horticultural interests of the State by the suppression and extermination of the San Jose scale, peach-yellow, pear-blight and other injurious insect pests and plant diseases, and to create the offices of "State Entomologist," "State Pathologist," and "State Horticulturalist," and to appropriate a sum of money therefor.

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That sections 51, 52, 53, 54, 55, 56, 57 and 58 of Article XLVIII of the Code of Public General Laws, title "Inspection," sub-title "Trees and Nursery Stock," as passed by the General Assembly of Maryland, session 1896, chapter 290, be and the same are hereby repealed and re-enacted to read as follows:

51. That a State Horticultural Department be established for the State of Maryland; that its purpose is to suppress and eradicate the San Jose scale, peach-yellow, pear-blight and other injuriously dangerous insect pests and plant diseases throughout the State of Maryland.

52. That the Professor of Entomology, the Professor of Vege

table Pathology, and the Professor of Horticulture of the Maryland Agricultural College and Experiment Station shall be the State Entomologist, State Pathologist and State Horticulturalist, respectively.

53. That the said Horticultural Department shall be under the control of the Board of Trustees of the Maryland Agricultural College and Experiment Station, to whom the officers created under this Act shall be responsible; that the salary of the State Entomologist and State Pathologist shall be fixed by the said board of trustees, and the said board shall likewise fix the compensation of any assistant or assistants, employe or employes, and control all expenses thereof. That the expenses of said department shall be paid out of an appropriation hereinafter provided for, and that said board of trustees be invested with all powers necessary to carry into effect the provisions of this Act; but no expenses shall be incurred beyond the amount appropriated.

54. That it shall be the duty of said State Entomologist and State Pathologist, their assistants and employes, under the control of Trustees of said College, to seek out and suppress all pernicious insect pests and contagious diseases hereinbefore mentioned as destructive to horticultural and agricultural interests of this State, and conduct experiments when necessary to accomplish that end.

55. That in order to accomplish the purposes of this Act, the State Entomologist and the State Pathologist, their assistants and employes, or any other officer, assistant or employe appointed by said board of trustees, are hereby authorized to enter upon any public premises, parks, cemeteries, or other premises, or upon any land of any firm, corporation or private individval within the State of Maryland for the purpose of inspection, destroying, treating or experimenting upon the insects and diseases aforesaid. Should any insect or disease found by said State Entomologist or State Pathologist, or by any other officer appointed by said trustees, be, in their opinion, capable of eradication without the destruction of the tree or plant, then said officers are to treat or cause to be treated with proper remedies and appliances all such trees, vines, shrubs, plants and grains. Further, said State officers shall treat or have

treated, in order to prevent the dissemination of the aforesaid insects or diseases, any and all suspicious trees, vines, shrubs, plants and grains found to be in a dangerous proximity to those infested as aforesaid.

56. That should any of the officers aforesaid, through their assistants and employes, or by any notification whatsoever, find any fruit trees, vines, shrubs, plants or grains, infested or diseased with the aforesaid insects or diseases, the aforesaid officers shall mark or tag in some conspicuous way, all trees, vines, shrubs, plants or grains infested with the aforesaid diseases and shall give notice in writing to the owner or owners, tenants or person in charge of such premises of the condition thereof, and thereupon, if such person or persons so notified shall not within ten (10) days after notification, destroy or treat the same in accordance with regulations and rules of said trustees, a copy of which will be sent on application to any person, then said trustees shall, through their officers, assistants or employes, destroy or treat all such trees, plants, vines, shrubs and grains, and the State officers shall file a statement of the expenses of such destruction or treatment with the trustees of said college, and said trustees shall transmit a copy of such statement and account of such expenditure, with the usual affidavit attached thereto to be made by the State officers, which shall be sufficient evidence to prove the claim to the State's Attorney of the county where the owner of such premises resides, and said attorney is directed to collect the same and account to the Trustees of the Maryland Agricultural College therefor.

57. That it shall be the duty of said trustees to send the State Entomologist, or the State Pathologist, or their duly authorized assistants, at least once a year into each county of the State for the purpose of determining by inspection the healthfulness and general condition of the horticultural and agricultural interests.

58. That it is hereby also made the duty of the said board of trustees, through the State Entomologist and the State Pathologist, or their duly authorized assistants, to inspect at least once in every six (6) months, all nurseries of trees, vines, shrubs and plants, subject to the aforesaid insects or diseases within the State, and if found free, so far as can be determined by inspection, from the

aforesaid insects or diseases, to give to the owner or owners or persons in charge of said nurseries, a certificate of inspection showing such nurseries or premises to be apparently free from such insects and diseases. If any of the aforesaid insects or diseases should be found in any nursery or orchard, or any premises within the State where nursery stock is grown, the aforesaid officers shall cause to be destroyed or treated such portion of such nursery stock or other trees or plants as in their opinion may be necessary, and shall release all other nursery stock grown upon said premises, and issue a certificate of inspection to the owner or owners as herein provided for; and if such infested or diseased trees, vines, plants or shrubs be destroyed by the aforesaid officers, then the owners shall pay the cost thereof, and if he refuse to pay the same it shall be collected as prescribed in section 56. No nurseryman, broker, agent, dealer or other person shall be permitted to sell, ship, send out, or give away, by mail, express, freight or otherwise, any trees, vines, shrubs, plants, buds or cuttings from any such nurseries or premises, without accompanying the same, with a copy of the said certificate printed upon a tag or label not easily destroyed, the same to be firmly attached in some conspicuous position upon each carload, box, bale or package so sent out or delivered.

SEC. 2. *And be it enacted by the General Assembly of Maryland*, That the following sections be and the same are hereby added to Article XLVIII of the Code of Public General Laws, title "Inspections," sub-title "Horticultural Department," to be designated as sections 59, 59 A, 60, 61, 62, 63, 64 and 65.

59. That should any nurseryman, agent, broker, dealer or other person send out or deliver within the State, or transport to any other State or Territory, or the District of Columbia, trees, vines, shrubs, plants, buds or cuttings, subject to the attacks of insects and diseases above provided for, without attaching a copy of said certificate, deface or destroy said certificate, or wrongfully attach a certificate, he shall be adjudged guilty of a misdemeanor, and shall upon conviction before any justice of the peace be fined a sum not less than ten dollars ($10.00) or more than one hundred dollars ($100.00) and costs of prosecution for each and every

offense, and stand committed until such fine and costs are paid, and the fines so collected shall be paid to the trustees of the said college, and be added to the funds herein provided for carrying out the provisions of this Act.

59 A. That all trees, plants, vines, shrubs, buds or cuttings, commonly known as nursery stock, grown or handled by each and every nurseryman within this State, and subject to the attacks of the aforesaid insects or disease, shall be fumigated by the nurseryman owning the same with hydrocyanic acid gas in buildings or enclosures inspected and approved by the aforesaid State officers under their discretion.

60. That when any trees, plants, shrubs, vines, buds or cuttings, commonly known as nursery stock are shipped into the State from any other State or Territory, or the District of Columbia to any nurseryman, broker, dealer, agent or other person in this State, every carload, bale, box or package thereof shall be plainly labeled on the outside with the name of the consignor, the name of the consignee, and a certificate showing that the contents have been inspected by a qualified State or government officer, and that the trees, plants, vines, shrubs or cuttings therein contained are apparently free from the insects and diseases herein provided for. Whenever any trees, plants, vines, shrubs, buds or cuttings are shipped into this State from any other State or Territory, or the District of Columbia, without such certificate plainly fixed on the outside of each carload, box, bale or package, the agent of the transportation company, firm or person receiving same shall not deliver said nursery stock to the consignee or agent representing the consignor, and said agent of the transportation company, firm or person, shall notify the State Entomologist or State Pathologist at the Maryland Agricultural College, and said State officer receiving such notification shall immediately notify any justice of the peace of this State to issue a summons for the consignee, and the agent or consignor, if he be known, of such carload, bale, box or package of nursery stock, to appear before him on a certain day to be named therein, to show why such trees, plants, vines, shrubs, buds or cuttings should not be seized as being in violation of the provisions of this Act, and on trial thereof, if said justice be satis-

fied that the provisions of this Act have been violated, said justice shall order said agent or consignee to return such carload, box, bale or package of trees, plants, shrubs, vines, buds or cuttings immediately to the shipper or consignor, unless said consignee or agent of the consignor at his expense, shall forthwith have said nursery stock examined by the State Entomologist and State Pathologist of this State, and such officers certify to such justice of the peace that said nursery stock is apparently free from the insects and diseases mentioned herein, and tag every such carload, box, bale and package inspected by said officers, with their certificate of inspection, and if said agent or consignee shall fail to have said nursery stock examined by said State officials, or fail to return such carload, box, bale or package thereof, then said justice of the peace shall order and direct the constable or sheriff to burn and destroy all such trees, plants, shrubs, vines, buds or cuttings that have been shipped into this State in violation of this Act.

61. That whenever any agent of a transportation company, firm or person shall receive a carload, box, bale or package of trees, plants, shrubs, vines, buds or cuttings, without a certificate attached, as provided for in section 60 of this Act, and shall fail to notify the State Entomologist or State Pathologist of this fact immediately upon the arrival of such nursery stock, and before delivering the same to the consignee, said agent of the transportation company, firm or person shall be adjudged guilty of a misdemeanor, and shall upon conviction before a justice of the peace, be fined a sum not less than ten dollars ($10.00) nor more than one hundred dollars ($100.00) and costs of prosecution for each and every offense, and stand committed until such fine and costs are paid; and the fines so collected shall be paid to the trustees of said college to be added to the funds herein provided for carrying out the provisions of this Act. If any nurseryman, dealer or agent sell, ship or deliver any trees, plants, shrubs or vines into or in this State, which is infested with San Jose scale, peach-yellow, pear-blight or other injurious diseases, and upon examination by the State Pathologist, State Entomologist or their assistants, is condemned by being so infested, the said trees, plants, vines and shrubs shall be destroyed, and the nurseryman, dealer

or agent shall forfeit the value of such stock, and shall not collect the same from the purchaser or consignee.

62. That the State Entomologist, State Pathologist and State Horticulturalist shall submit annually a written report on or before the first day of February of their inspections and investigations to the board of trustees, which shall be transmitted to the Governor of the State and the General Assembly, and published, as are the reports of other State organizations, and distributed among the people of the State as bulletins of the Maryland Agricultural Experiment Station.

63. That the report of the present State Entomologist, including the work done by him up to the date of the passage of this Act, shall be published and distributed as indicated and provided for in section 62 of this Act, as the First Annual Report of the Maryland State Entomologist.

64. That the sum of ten thousand dollars the first year, and eight thousand dollars annually thereafter be and is hereby appropriated in order to carry out the provisions of this Act and properly provide for the above described inspections; to employ men qualified for their respective positions; to procure the requisite facilities and equipment necessary for the proper performance of the duties herein incurred, and to offer means of support for investigation in addition to the inspection work of the State officers, and the dissemination of information that will promote the horticultural and agricultural interests of this State.

65. That the Comptroller be and that he is hereby authorized to issue his warrant upon the Treasurer of this State for the said sum of ten thousand dollars for the year eighteen hundred and ninety-eight, and the sum of eight thousand dollars annually thereafter, out of any funds not otherwise appropriated; that the said sum of money shall be payable to the Maryland Agricultural College on or before the first of October of each fiscal year, and the first yearly payment shall be made during the fiscal year ending September first, eighteen hundred and ninety-eight.

Sec. 3. *And be it enacted*, That this Act shall take effect from the date of its passage.

Approved April 9th, 1898.